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WITH A SEPARATELY-PAGED APPENDIX OF

MINERALOGICAL ABSTRACTS

EDITED BY L. J. SPENCER, F.R.S.

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MINERALOGICAL SOCIETY

(*Instituted February* 3, 1876)

BYE-LAWS[1]

1. The object of the Mineralogical Society of Great Britain and Ireland, with which the Crystallological Society was amalgamated on December 11, 1883, shall be to advance the knowledge of Mineralogy and also of Crystallography and Petrology.

2. The Society shall consist of Ordinary Members and Honorary Members.

Ordinary Members

3. Every candidate for Ordinary Membership shall be proposed by two Ordinary Members, one, at least, of whom shall have personal knowledge of the candidate.

4. Elections to Ordinary Membership shall be made by the Council, and shall be confirmed at the ensuing General Meeting by a majority consisting of three-fourths of the Members present and voting.

5. Ordinary Members shall pay an entrance fee of one guinea and an annual subscription of one guinea. They shall be entitled to compound for the annual subscription by a single payment of fifteen guineas, but Members who have paid their annual subscriptions for twenty years shall be entitled to compound for ten guineas.

6. Annual subscriptions shall be due on the first of January of each year, but Members elected after the first of October shall not be required to pay a subscription for the then current year.

7. No person elected an Ordinary Member of the Society shall be entitled to any of the privileges of Membership until he shall have paid his entrance fee and first annual subscription; and unless these be received within four calendar months of the date of his election, or within such further time as the Council may determine, the election of such person shall be void.

8. At the first Meeting of the Council in each calendar year the name of any Ordinary Member who is in default with his annual subscription for the preceding year shall be brought before the

[1] Revised at the Anniversary Meeting of November 3, 1931.

Council, and an intimation that this action has been taken shall be communicated to the Member in writing at his last known address. If at the first meeting in the next ensuing year the Member be still in default and the default be for the two preceding years the Council shall be empowered to erase his name from the list of Members.

Honorary Members

9. Ten persons, non-resident in Great Britain or Ireland, may be elected Honorary Members. They shall pay neither entrance fee nor annual subscription. They shall not be entitled to vote on any question relating to the management or business of the Society, nor to serve on the Council of the Society, nor to fill any Office in the Society, but subject to these restrictions shall be entitled to every other privilege accorded to Ordinary Members.

10. Every candidate for Honorary Membership shall be proposed by two Members of the Council, and the election shall be by the Council, and shall be confirmed at the ensuing General Meeting by a majority consisting of three-fourths of the Members present and voting.

Council

11. The Society shall be governed by a Council, consisting of a President, two Vice-Presidents, a General Secretary, a Foreign Secretary, a Treasurer, an Editor of the Journal, the Trustees of the Society, and twelve Ordinary Members.

12. All Members of the Society who have served the office of President shall be Life-Members of the Council.

13. The Council shall be elected annually at the Anniversary Meeting.

14. Four Ordinary Members of Council shall retire annually, and shall not be eligible for re-election until the next Anniversary Meeting.

15. The Council shall prepare a list of Members nominated for election as Officers and Ordinary Members of Council.

16. The election of Council shall be effected by the agency of voting papers containing the list nominated by the Council. They shall be sent by the General Secretary, at least four weeks before the Anniversary Meeting, to every Ordinary Member of the Society, and every

such Member shall be entitled to substitute the names of any other Ordinary Members of the Society for those on the list.

17. The voting papers shall be returned by the Members to the General Secretary, and shall be examined at the Anniversary Meeting by two Scrutineers appointed by the Chairman, who shall on their report declare the result of the election. The voting papers need not be signed.

18. The Council shall have power to appoint Officers, and to co-opt Ordinary Members of Council, to fill vacancies in the Council caused by death or resignation during the interval between two Anniversary Meetings.

19. Meetings of the Council shall be summoned by the General Secretary at the order of the President or of not fewer than three Members of the Council; at such meetings six shall be a quorum, of whom one shall be either the President, a Vice-President, the Treasurer, or the General Secretary.

20. A Report of Council on the work and progress of the Society shall be submitted to each Anniversary Meeting.

Property and Trustees

21. Two or more Trustees shall be appointed by the Council from amongst the Members of the Society, and the invested property of the Society shall stand in their names.

22. The Council may from time to time make such purchases of books or other movable effects as they may consider to be required for the furtherance of the objects of the Society and the conduct of its business. They may also dispose of such effects by sale, if not required, provided that no instruction to sell at any one time effects the total value of which exceeds the sum of fifty pounds shall be valid unless endorsed by a resolution passed at a General Meeting of the Society.

23. The Council may authorize the investment of money and the sale of investments. A copy of a resolution of the Council authorizing the sale or purchase of investments, certified by the Chairman of the meeting at which it was passed, shall be sufficient authority to the Trustees to give effect to such resolution.

24. Composition fees shall be treated as Capital, and all moneys so received and all other moneys the investment of which has been authorized by the Council shall be invested in such stock or security

as the Council may select from amongst the stocks and securities authorized by Law for the investment of trust moneys.

25. No Member of the Society is or shall be entitled to any distinct or separate share in the estate, revenue, or effects of the Society, and the Society shall not and may not make any dividend, gift, division, or bonus in money unto or between any of its Members, provided that nothing herein shall prevent the payment in good faith of reasonable and proper remuneration, or of an honorarium in lieu thereof, to any Member of the Society, in return for services rendered to the Society, nor prevent the distribution of copies of the publications of the Society gratis among the Members of the Society.

26. In the event of a dissolution of the Society its property and effects (whether funded or otherwise) shall be disposed of by gift to such other Societies or Institutions or in such other manner as may be decided by the vote of a majority of at least three-fourths of those present and voting at a General Meeting of the Society summoned with notice of the proposed disposal, provided that no individual Members shall benefit thereby, and that such gift or other disposal shall be for the benefit of Mineralogy or its allied Sciences.

Meetings

27. General Meetings of the Society shall be summoned from time to time as may be deemed necessary by the Council, or on the requisition of any ten Members of the Society. One of these meetings in each year shall be termed the Anniversary Meeting. Any meeting of the Society summoned for the purpose of considering special matters relating to the business of the Society shall be termed a Special General Meeting, and the summons thereto shall contain the resolutions or other matter to be considered, and shall be issued to the Members not less than four weeks before the date fixed for the Meeting.

Journal

28. The Numbers of the *Mineralogical Magazine and Journal of the Society* shall be issued at such intervals as the Council shall determine, and shall be sent, postage paid, to every Member of the Society, other than annual subscribers who are in default with their annual subscriptions for the preceding calendar year.

Auditors and Balance Sheet

29. One Member of the Council and one Ordinary Member of the Society, who is not a Member of the Council, shall be appointed annually by the Council to audit the accounts of the Society.

30. No auditor shall serve for more than three years in succession.

31. The audited Balance Sheet, after submission to the Council, shall be published in the Journal of the Society as early as possible in every year.

Expulsion of Members

32. A majority consisting of three-fourths of the whole Council shall have power to expel a Member from the Society, but a Member who has been expelled shall have a right of appeal to the Society. Notice of such appeal to the Society shall be sent by such Member to the General Secretary within four weeks of the expulsion, and the appeal shall be considered by the Society at the next Anniversary Meeting or at a Special General Meeting; a majority of the votes recorded at such Meeting sufficing to confirm or annul the decision of the Council.

Alteration of the Bye-laws

33. The Bye-laws may be altered only at an Anniversary Meeting or at a Special General Meeting duly summoned for the purpose of considering the proposed alterations, and only by a majority consisting of three-fourths of the Members present and voting. Notice of changes proposed to be made in the Bye-laws shall be communicated by the General Secretary to every Ordinary Member of the Society at least four weeks before the Anniversary Meeting or the Special General Meeting summoned for the purpose of their consideration.

Obligation Book

34. Ordinary Members, by payment of their entrance fee, signify their acceptance of any Bye-laws approved by the Society; and every Member of the Society shall sign an Obligation Book.

Interpretation

35. In the interpretation of the Bye-laws words in the masculine gender only shall include the feminine gender also.

LIST OF MEMBERS

(*February*, 1935)

HONORARY MEMBERS

Year of Election.

1926 Brauns, Reinhard, Emeritus Professor of Mineralogy and Petrography in the University of Bonn. *Endenicher-Allee, Bonn, Germany.*

1895 Brögger, Waldemar Christofer. *The University, Oslo, Norway.*

1909 Cesàro, Giuseppe. Emeritus Professor of Mineralogy in the University of Liége. 1 *Place Cockerill, Liége, Belgium.*

1897 Dana, Edward Salisbury. *Yale University, New Haven, Connecticut, U.S.A.*

1934 Fersman, Aleksandr Evgenievich. Director of the *Lomonosov Institute, Academy of Sciences, Moscow, Russia.*

1933 Goldschmidt, Victor Moritz. Professor of Mineralogy in the University of Göttingen. *Wagnerstrasse* 8, *Göttingen, Germany.*

1900 Lacroix, Antoine François Alfred. Professor of Mineralogy in the Muséum National d'Histoire Naturelle. 61 *Rue de Buffon, Paris V, France.*

1933 Niggli, Paul. Professor of Mineralogy in the Technical High School of Zürich. *Mineralogical Institute, Sonneggstrasse* 5, *Zürich* 6, *Switzerland.*

1913 Wallerant, Frédéric. Honorary Professor of Mineralogy in the University of Paris. 23 *Rue Émile-Dubois, Paris XIV, France.*

ORDINARY MEMBERS[1]

A Annual Subscribers.
L Life-Members.
C Belonged to the Crystallological Society at the time of the amalgamation of the two Societies, December 11, 1883

Year of Election.

A 1931 Adams, Leason Heberling, B.S. *Geophysical Laboratory, 2801 Upton Street, Washington, D.C., U.S.A.*

A 1933 Alderman, Arthur Richard, M.Sc., F.G.S., *Geology Dept., The University, Adelaide, Australia.*

A 1931 Aminoff, Gregori, Professor, *Mineralogiska Avdelning, Naturhistoriska Riksmuseet, Stockholm* 50, *Sweden.*

A 1928 Anderson, Basil William, B.Sc., F.C.S. *Ladylane, Lodge Hill, Ditchling, Sussex.*

L 1926 Andrew, Gerald, M.Sc., F.G.S. *Geology Dept., Egyptian University, Cairo, Egypt;* and 8 *Calland Avenue, Hyde, Cheshire.*

A 1922 Arkell, Daniel John, B.Sc. *St. Edward's College, Cottonera, Malta.*

L 1900 Ashcroft, Frederick Noel, M.A., F.C.S., F.G.S., F.R.G.S. 1 *Egerton Gardens, South Kensington, London, S.W.* 3.

A 1922 Balsillie, David, B.Sc., F.R.S.E., F.G.S. *Dept. of Geology, Royal Scottish Museum, Edinburgh.*

A 1932 Bandy, Mark Chance, A.B., M.A., E.M. *Redfield, Iowa, U.S.A.*

A 1927 Bannister, Frederick Allan, M.A. *Mineral Dept., British Museum of Natural History, South Kensington, London, S.W.* 7; and 29 *Waddon Court Road, Croydon, Surrey.*

A 1913 Barreto, Dr. Antonio de Barros. Professor of Mineralogy and Geology in the Polytechnic School of São Paulo. *Rua Maranhão* 60, *Hygienopolis, São Paulo, Brazil.*

A 1928 Beard, Edward Harold, B.Sc. *Mineral Resources Dept., Imperial Institute, South Kensington, London, S.W.* 7; and 1 *Dolcoath Road, Camborne, Cornwall.*

L 1922 Belaiew, Nicholas Timothy, Colonel, C.B., M.I.M.E. 1 *Rond-Point Bugeaud, Paris XVI, France.*

L 1888 Bemrose, Henry Howe, J.P., M.A., Sc.D., F.G.S. '*Ash Tree House*', *Osmaston Road, Derby.*

[1] Corrections for this List should be sent to the General Secretary.

Year of Election.

1934 Benson, William Noel, B.A., D.Sc., F.G.S., Professor of Geology, *University of Otago, Dunedin, New Zealand.*

1933 Berman, Harry. *Mineralogical Museum, Harvard University, Cambridge, Massachusetts, U.S.A.*

1929 Bernal, John Desmond, M.A. *Dept. of Mineralogy and Petrology, The University, Cambridge.*

1906 Blake, George Stanfield, B.Sc., A.R.S.M., F.G.S. Geological Survey of Palestine. *P.O. Box* 585, *Jerusalem, Palestine.*

1929 Blight, Percy. *Mina dos Lagares, Satam, Beira Alta, Portugal.*

1923 Blumenthal, Maurice. 558 *Quincy Street, Brooklyn, New York, U.S.A.*

1922 Boswell, Percy George Hamnall, O.B.E., D.Sc., A.R.C.S., F.R.S. Professor of Geology, *Imperial College of Science and Technology, South Kensington, London, S.W.* 7.

1931 Bottley, Edward Percival. 30 *Church Street, Chelsea, London, S.W.* 3.

1927 Boubée, Nérée, Licencié-ès-Sciences. 3 *Place St. André-des-Arts, Paris VI, France.*

1927 Bowen, Norman Levi, M.A., B.Sc., Ph.D. *Geophysical Laboratory,* 2801 *Upton Street, Washington, D.C., U.S.A.*

1897 Bowman, Herbert Lister, M.A., D.Sc., F.G.S., F.C.S. Professor of Mineralogy in the University of Oxford. *Dept. of Mineralogy, University Museum, Oxford.*

1923 Brady, Oscar Lisle, B.A., D.Sc., D.I.C., F.I.C., F.C.S. Reader in Organic Chemistry, University of London, University College. 5 *Woodside Avenue, Beaconsfield, Buckinghamshire.*

1923 Bragg, Sir William Henry, O.M., K.B.E., M.A., D.Sc., F.R.S. Director of the Royal Institution. 21 *Albemarle Street, London, W.* 1.

1920 Bragg, William Lawrence, O.B.E., M.A., F.R.S. Professor of Physics, *The University, Manchester.*

1919 Brammall, Alfred, Ph.D., D.Sc., D.I.C., F.G.S., A.I.M.M. Assistant Professor in Petrology, *Dept. of Geology, Imperial College of Science and Technology, South Kensington, London, S.W.* 7.

	Year of Election.	
A	1922	BROADHEAD, James. 15 *Langholm Crescent, Darlington, Co. Durham.*
A	1923	BUCKLEY, Harold Eugene, D.Sc., F.C.S. Lecturer in Crystallography, University of Manchester. '*Bradda*', 100 *Hazelhurst Road, Worsley, near Manchester, Lancashire.*
A	1921	BULL, Alfred Joseph, M.Sc., F.Inst.P., F.G.S. *L.C.C. School of Photo-engraving,* 6 *Bolt Court, Fleet Street, London, E.C.* 4.
A	1926	BURRI, Conrad Robert, Ph.D. Professor in the *Mineralogical Institute, Sonneggstrasse* 5, *Zürich* 6, *Switzerland.*
L	1885	BUTLER, Francis Henry, M.A., A.R.S.M., L.S.A. (Lond.). 11 *Alfred Road, Sutton, Surrey.*
A	1919	BUTTGENBACH, Henri Jean Francois. Professor of Crystallography and Mineralogy in the University of Liége. 13 *Quai de Rome, Liége, Belgium.*
A	1923	CAHN, Lazard. 6 *North Eighth Street, Colorado Springs, Colorado, U.S.A.*
A	1924	CAMPBELL, Robert, M.A., D.Sc., F.R.S.E., F.G.S. Lecturer in Petrology, University of Edinburgh. '*Maryton*', *Woodhall Road, Colinton, Edinburgh.*
A	1928	CLARKE, Edward de Courcy, M.A., A.I.M.M. *Dept. of Geology, University of Western Australia, Perth, Western Australia.*
L	1927	CLEGG, Edward Leslie Gilbert, B.Sc. Assistant Superintendent, *Geological Survey of India,* 27 *Chowringhee Road, Calcutta, India.*
A	1931	COCKBURN, Alexander Murray, B.Sc., Ph.D. *Grant Institute of Geology, King's Buildings, West Mains Road, Edinburgh.*
L	1927	COKE, Basil Elmsley, Lieut.-Colonel R.E. (retired), O.B.E., M.A., F.G.S. '*Littlehill*', *Harpsden, Henley-on-Thames, Oxfordshire.*
A	1913	COLLINGRIDGE, Harvey, B.Sc., A.M.I.C.E. 24 *Canfield Gardens, West Hampstead, London, N.W.* 6.
L	1923	COMBE, Arthur Delmar, F.G.S. *Geological Survey, Entebbe, Uganda, East Africa.*
L	1900	COOMARASWAMY, Ananda K., D.Sc., F.L.S., F.G.S., M.R.A.S. Keeper of Indian Art, *Museum of Fine Arts, Boston, Massachusetts, U.S.A.*

	Year of Election.	
A	1924	Coussmaker, Arthur Blakeney, M.C., F.G.S., A.I.M.M. 78 *Hatton Garden, London, E.C.* 1.
A	1907	Crook, Thomas, A.R.C.Sc.I., F.G.S. *Mineral Resources Dept., Imperial Institute, South Kensington, London, S.W.* 7.
L	1899	Cullis, Charles Gilbert, D.Sc., F.G.S., M.I.M.M. Professor of Economic Mineralogy, *Imperial College of Science and Technology, South Kensington, London, S.W.* 7.
A	1935	Davidson, Charles Findlay, B.Sc., F.G.S. *Geological Survey and Museum, Exhibition Road, South Kensington, London, S.W.* 7.
A	1926	Davies, George MacDonald, M.Sc., F.G.S. Reader in Geology, Birkbeck College, London. 63 *Beechwood Road, Sanderstead, Surrey.*
L	1885	Daw, John Williams. *Axim, Gold Coast Colony, West Africa;* and '*Woodhaven*', *Walton-on-Thames, Surrey.*
L	1898	De Castro, John Paul, M.A., F.C.S., F.I.C. 47 *Kingsclere Road, Basingstoke, Hants.*
A	1925	Dewey, Henry, F.G.S. *Geological Survey and Museum, Exhibition Road, South Kensington, London, S.W.* 7.
A	1933	Dollar, Archibald Thomas John, B.Sc., F.G.S. 72 *Maida Vale, London, W.* 9.
A	1925	Double, Ivan Sidney, M.Sc., F.G.S. *Geological Dept., The University, Liverpool.*
L	1928	Douglas, George Vibert, M.C., M.Sc., F.G.S. Professor of Geology, *Dalhousie University, Halifax, Nova Scotia.*
L	1910	Drugman, Julien Léon Eugène, Ph.D., M.Sc. 33 *Rue Edmond Picard, Uccle, Brabant, Belgium.*
A	1932	Earle, Kenneth Wilson, D.Sc., F.G.S. '*Mollcroft*', *Potten End, Berkhamsted, Herts.*
L	1926	Eckermann, Harry von, Ph.D. Lecturer in Mineralogy, University of Stockholm. *Edeby pr. Sparreholm, Sweden.*
L	1918	Edge, Arthur Broughton, M.B.E., A.R.S.M., A.R.C.S., B.Sc., F.C.S., F.G.S. *c/o Royal School of Mines, South Kensington, London, S.W.* 7.
A	1927	Elles, Miss Gertrude Lilian, M.B.E., D.Sc., F.G.S. *Newnham College, Cambridge.*
A	1925	Ellsworth, Hardy Vincent, M.A., Ph.D. *Geological Survey of Canada, Ottawa, Canada.*

	Year of Election.	
A	1920	ENGLISH, George Letchworth. 50 *Brighton Street, Rochester, New York, U.S.A.*
A	1929	EYLES, Victor Ambrose, B.Sc. *Geological Survey and Museum, Exhibition Road, South Kensington, London, S.W.* 7.
A	1924	FABRY, Richard John Charles, A.R.C.S., B.Sc. *Geological Survey of Canada, Ottawa, Canada.*
L	1926	FEARNSIDES, William George, M.A., F.R.S. Professor of Geology, University of Sheffield. 11 *Ranmoor Crescent, Sheffield.*
A	1915	FERMOR, Lewis Leigh, O.B.E., A.R.S.M., D.Sc., F.R.S. Director of the *Geological Survey of India*, 27 *Chowringhee Road, Calcutta, India.*
A	1935	FLEET, William Frederick, M.Sc., Ph.D., F.G.S. *Chelsea Polytechnic, South Kensington, London, S.W.* 3; and '*Branscombe*', *Briton Hill Road, Sanderstead, Surrey.*
L	1895	FLETCHER, Rev. Mark, M.A., M.Sc., F.G.S. Lecturer in Mineralogy in the Armstrong College, Newcastle-on-Tyne. *Long Benton Vicarage, Forest Hall, Northumberland.*
L	1902	FLETT, Sir John Smith, K.B.E., M.A., LL.D., D.Sc., F.R.S. Director of the Geological Survey of Great Britain. *Geological Survey and Museum, Exhibition Road, South Kensington, London, S.W.* 7.
A	1926	FORD, Hugh Alexander, H.B.M. Consul-General, *The British Consulate General, Boston, Massachusetts, U.S.A.*
A	1923	GARNETT, Cecil Stevenson, F.C.S., F.G.S. 6 *The Strand, Derby.*
A	1933	GIBBS, Agnes, Lady, B.Sc., F.G.S., F.R.G.S. '*Little House*', *D'Oyley Street, London, S.W.* 1.
A	1905	GOODCHILD, Wilbert, M.B., Ch.B. *Blencathra Sanatorium, Threlkeld, Penrith, Cumberland.*
A	1922	GORDON, Hugh Septimus, M.I.M.M., F.G.S. 10 *Nevill's Court, Fetter Lane, London, E.C.* 4.
A	1923	GORDON, Samuel George. *Academy of Natural Sciences, Logan Square, Philadelphia, Pennsylvania, U.S.A.*
A	1923	GORDON, William Thomas, M.A., D.Sc., F.R.S.E., F.G.S. Professor of Geology, *King's College, Strand, London, W.C.* 2.

Year of Election.

L 1903 GRABHAM, George Walter, O.B.E., M.A., F.G.S. Formerly Geologist to the Sudan Government. *P.O. Box* 178, *Khartoum, Sudan.*

L 1913 GRAHAM, Richard Percival Devereux, B.A., D.Sc., F.R.S.C. Assistant Professor of Mineralogy, *McGill University, Montreal, Canada.*

A 1924 GRANTHAM, Donald Robert, Ph.D., A.R.S.M., F.G.S. *Geological Survey, Georgetown, British Guiana*; and '*Carrickfergus*', *Deepdene Avenue, Dorking, Surrey.*

A 1929 GRAY, George Wynter, A.R.S.M. 3 *Lombard Street, London, E.C.* 3.

A 1923 GREENWOOD, Gilbert, M.Sc. *Judson College, Rangoon, Burma.*

A 1921 GREGORY, Albert George Frederick. '*Melrose*', *Woodchurch, Ashford, Kent.*

A 1931 GROVES, Arthur William, Ph.D., M.Sc., D.I.C., F.G.S. 36 *Albert Mansions, Albert Bridge Road, Battersea Park, London, S.W.* 11.

A 1933 HADFIELD, Sir Robert Abbott, Bart., D.Sc., F.R.S. 22 *Carlton House Terrace, London, S.W.* 1.

A 1930 HALL, Thomas Clifford Fitzwilliam, M.I.M.M. *Royal Societies Club,* 63 *St. James's Street, London, S.W.* 1; and '*Trevu*', *Camborne, Cornwall.*

A 1912 HALLIMOND, Arthur Francis, M.A., Sc.D., F.G.S. Assistant Curator, *Geological Survey and Museum, Exhibition Road, South Kensington, London, S.W.* 7.

A 1885 HARKER, Alfred, M.A., LL.D., F.R.S. Emeritus University Reader in Petrology, *St. John's College, Cambridge.*

A 1931 HART, Robert, B.Sc., Ph.D. *Macaulay Institute for Soil Research, Craigiebuckler, Aberdeen.*

L 1900 HARTLEY, Sir Harold Brewer, Kt., C.B.E., M.C., M.A., F.R.S. 14 *North Court, Wood Street, Westminster, London, S.W.* 1.

A 1917 HARWOOD, Henry Francis, M.Sc., Ph.D., A.I.C., F.G.S. Lecturer in Chemistry, *Imperial College of Science and Technology, South Kensington, London, S.W.* 7.

	Year of Election.	
A	1921	Hawkes, Leonard, D.Sc., F.G.S. Reader in Geology, University of London. *Bedford College, Regent's Park, London, N.W.* 1.
A	1928	Heide, Fritz, D.Ph. *Schillerstrasse* 12, *Jena, Germany.*
A	1929	Hey, Max Hutchinson, M.A., B.Sc., F.C.S. *Mineral Dept., British Museum of Natural History, South Kensington, London, S.W.* 7.
L	1907	Hilton, Harold, M.A., D.Sc. Professor of Mathematics in the University of London. *Bedford College, Regent's Park, London, N.W.* 1.
A	1927	Hitchen, Charles Stansfield, B.Sc., Ph.D., A.R.C.S., D.I.C., F.G.S. 90 *Elm Park Mansions, Park Walk, Chelsea, London, S.W.* 10.
A	1928	Hodge, Matthew Burnop, M.Sc., Ph.D. *Bankfield Museum, Halifax, Yorkshire.*
L	1896	Holland, Sir Thomas Henry, K.C.S.I., K.C.I.E., A.R.C.S., D.Sc., LL.D., F.R.S. Principal of The University, Edinburgh. *Blackford Brae, Edinburgh.*
A	1929	Hollingworth, Sidney Ewart, M.A., D.Sc., F.G.S. '*Whitecot*', *Addington Road, West Wickham, Kent.*
A	1914	Holmes, Arthur, D.Sc., D.I.C., A.R.C.S., F.G.S. Professor of Geology in the University of Durham. *Science Laboratories, South Road, Durham.*
A	1931	Honess, Arthur Pharaoh. Professor of Mineralogy, *Pennsylvania State College, State College, Pennsylvania, U.S.A.*
A	1908	Hopkins, Edward. 32–34 *Holborn Viaduct, London, E.C.* 1.
A	1925	Horn, Aubrey Evelyn. *Loup House, Axminster, Devon.*
A	1902	Howe, John Allen, O.B.E., B.Sc., F.G.S. 21 *Richmond Bridge Mansions, Twickenham, Middlesex.*
A	1928	Howling, Gerald Edward, B.Sc. *Mineral Resources Dept., Imperial Institute, South Kensington, London, S.W.* 7.
L	1890	Hutchinson, Arthur, O.B.E., M.A., Ph.D., F.R.S. Emeritus Professor of Mineralogy in the University of Cambridge, Master of *Pembroke College, Cambridge.*

Year of Election.

1931 Ito, Tei-ichi. Assistant Professor of Mineralogy, *Mineralogical Institute, Imperial University, Tokyo, Japan.*

1923 Jardine, Irvine George, B.Sc., F.G.S. 27 *Cecil Road, Upton Manor, London, E.* 13.

1925 Johnston, Robert Angus Alister, F.R.S.C. 112 *Old Forest Hill Road, Toronto 10, Canada.*

1905 Jones, Bernard Mouat, D.S.O., M.A., F.C.S. Principal of *The College of Technology, Manchester.*

1908 Jones, Owen Thomas, M.A., D.Sc., F.R.S. Professor of Geology, *Sedgwick Museum, Cambridge.*

1930 Jones, William Richard, D.Sc., M.I.M.M., F.G.S. *Dept. of Geology, Imperial College of Science and Technology, South Kensington, London, S.W.* 7.

1929 Kennedy, William Quarrier, D.Sc., Ph.D., F.G.S. *Geological Survey and Museum, Exhibition Road, South Kensington, London, S.W.* 7.

1917 Kitson, Sir Albert Ernest, C.M.G., C.B.E., F.G.S. Formerly Director of the Geological Survey of the Gold Coast. '*Benalta*', *Ireby Crescent, Beaconsfield, Buckinghamshire.*

1930 Kôzu, Shukusuké, D.Sc. Professor of Mineralogy, *Mineralogical Institute, Tohoku Imperial University, Sendai, Japan.*

1926 Kreutz, Stefan, Ph.D. Professor of Mineralogy and Crystallography in the University of Kraków. *Collegium Minus, Gołębia* 11, *Kraków, Poland.*

1926 Krishnan, Maharajapuram Sitaram, M.A., Ph.D., A.R.C.S., D.I.C. Assistant Superintendent, *Geological Survey of India,* 27 *Chowringhee Road, Calcutta, India.*

1922 Lake, Harry William, Colonel, C.M.G., M.I.M.M. 33 *Collingham Road, South Kensington, London, S.W.* 7.

1924 Lane, Alfred Church, A.B., Ph.D., Sc.D. Professor of Geology, *Tufts College, Postal District No.* 57, *Boston, Massachusetts, U.S.A.*

1923 Larsen, Esper Signius, Ph.D. Professor of Petrology. *Harvard University, Cambridge, Massachusetts, U.S.A.*

	Year of Election.	
A	1923	Leech, John George Chambré, A.R.S.M., F.G.S. 7 *Belvedere Grove, Wimbledon, London, S.W.* 19.
A	1929	Lightfoot, Ben, M.C., M.A., F.G.S. Director of the Geological Survey of Southern Rhodesia, *P.O. Box* 366, *Salisbury, Southern Rhodesia.*
A	1879	Louis, Henry, M.A., D.Sc., A.R.S.M., F.G.S. Emeritus Professor of Mining in the Armstrong College. 4 *Osborn Terrace, Jesmond, Newcastle-on-Tyne.*
A	1914	Macgregor, Alexander Miers, M.A., F.G.S. Geological Survey of Southern Rhodesia. *P.O. Box* 366, *Salisbury, Southern Rhodesia.*
A	1929	MacGregor, Archibald Gordon, M.C., B.Sc., F.R.S.E., F.G.S. Geological Survey of Great Britain (Scottish Office), '*Southpark*', 19 *Grange Terrace, Edinburgh.*
A	1935	MacGregor, Malcolm, Ph.D., M.Sc., D.I.C., F.G.S. 6 *Hocroft Road, London, N.W.* 2.
A	1929	Macgregor, Murray, M.A., D.Sc., F.R.S.E. Geological Survey of Great Britain (Scottish Office), '*Southpark*', 19 *Grange Terrace, Edinburgh.*
A	1925	Maclaren, James Malcolm, D.Sc., F.G.S. '*Burncoose*', *Gwennap, Redruth, Cornwall.*
A	1908	McLintock, William Francis Porter, D.Sc., F.R.S.E., F.G.S. Curator, *Geological Survey and Museum, Exhibition Road, South Kensington, London, S.W.* 7.
A	1921	McRobert, Rachel Workman, Lady, B.Sc., F.G.S. '*Douneside*', *Tarland, Aboyne, Aberdeenshire.*
A	1925	Marshall, Patrick, M.A., D.Sc., F.G.S. '*Hautere*', *Bellevue Road, Lower Hutt, Wellington, New Zealand.*
A	1927	Mathews, Charles William, F.G.S. 14 *Hatton Garden, London, E.C.* 1.
A	1930	Mauritz, Béla. Professor of Mineralogy and Petrology in the University of Budapest, *Muzeum-Körút* 4, *Budapest VIII, Hungary.*
A	1929	Mawson, Sir Douglas, Kt., O.B.E., D.Sc., B.E., F.R.S. Professor of Geology and Mineralogy, *University of Adelaide, South Australia.*
L	1919	Melmore, Sidney, B.Sc., F.G.S. '*Winkinghurst*', *Carr Lane, Acomb, York.*

Year of Election.

1923 MERWIN, Herbert Eugene, Ph.D. *Geophysical Laboratory*, 2801 *Upton Street, Washington, D.C., U.S.A.*

C MIERS, Sir Henry Alexander, Kt., M.A., D.Sc., LL.D., D.C.L., F.R.S. Honorary Professor of Crystallography in the University of Manchester. 18 *Aberdare Gardens, West Hampstead, London, N.W.* 6.

1912 MORGAN, Arthur Henry, A.M.I.C.E., M.I.M.M. Superintendent of the *Ruby Mines, Mogok, Upper Burma.*

1922 MOUNTAIN, Edgar Donald, M.A. Professor of Geology, *Rhodes University College, Grahamstown, South Africa.*

1932 MOURANT, Arthur Ernest, B.A., D.Phil. '*Maison de Haut*', *Longueville, St. Saviour, Jersey, Channel Islands.*

1924 MURRAY-HUGHES, Robert, F.G.S. *The Standard Bank of South Africa*, 10 *Clement's Lane, London, E.C.* 3.

1933 NOCKOLDS, Stephen Robert, B.Sc., Ph.D., F.G.S. *Geology Dept., The University, Manchester.*

1927 OGURA, Tsutoma, Professor of Geology, *Ryojun College of Engineering, Port Arthur, Manchuria.*

1920 ŌHASHI, Ryōichi. Professor of Geology and Mineralogy, *Akita Mining College, Akita, Japan.*

1926 PALACHE, Charles. Professor of Mineralogy, *Harvard University, Cambridge, Massachusetts, U.S.A.*

1922 PARKER, Robert Luling, Ph.D. Professor in the *Mineralogical Institute, Sonneggstrasse* 5, *Zürich* 6, *Switzerland.*

1915 PARSONS, Arthur Leonard. Assistant-Professor of Mineralogy, *University of Toronto, Canada.*

1923 PHEMISTER, James, M.A., D.Sc., F.R.S.E., F.G.S. Geological Survey of Great Britain (Scottish Office), '*Southpark*', 19 *Grange Terrace, Edinburgh.*

1926 PHEMISTER, Thomas Crawford, Sc.M., Ph.D., D.Sc., F.G.S. *St. John's College, Cambridge.*

1929 PHILLIPS, Alexander Hamilton, D.Sc. Professor of Mineralogy in Princeton University, 54 *Hodge Road, Princeton, New Jersey, U.S.A.*

On behalf of Mr. E. J. Wayland, Dr. L. J. Spencer exhibited crystals of alluvial gold from the Ankole district, Uganda.

The following papers were read:—

1. The form relations of the lead oxychlorides, laurionite, paralaurionite, and fiedlerite: by Prof. Charles Palache (read by Dr. L. J. Spencer) (vol. 23, p. 573).

2. The crystal-structure and optical properties of matlockite (PbFCl): by Mr. F. A. Bannister (vol. 23, p. 587).

3. Berthierite from Kisbánya, Carpathians: by Dr. V. Zsivny and Dr. L. Zombory (communicated by Dr. L. J. Spencer) (vol. 23, p. 566).

4. Beryllium minerals (euclase and phenakite) from Africa: by Dr. L. J. Spencer (vol. 23, p. 616).

5. Lusakite, a cobalt-bearing silicate from Northern Rhodesia: by Mr. A. C. Skerl and Mr. F. A. Bannister (vol. 23, p. 598).

6. The determination of small amounts of copper in rocks: by Dr. A. W. Groves (vol. 24, p. 35).

7. Thirteenth list of new mineral names: by Dr. L. J. Spencer (vol. 23, p. 624).

8. A new meteoric stone from Silverton, New South Wales: by L. J. Spencer (vol. 23, p. 569).

9. Studies on the zeolites. Part VIII. A theory of the vapour-pressure of zeolites: by Mr. M. H. Hey.

EXCERPT MINUTES OF COUNCIL MEETING.

Held in the Apartments of the Geological Society, Burlington House, London, W., November 1, 1934, *at* 4 *p.m.*

Sir Thomas H. Holland, F.R.S., President, in the Chair.

The resignation of Dr. B. H. Knight was received and accepted. Dr. L. Hawkes and Dr. W. R. Jones were nominated as auditors.

The draft Annual Report was read and after amendment approved.

A proposal to print brief abstracts of papers to be read at the meetings was discussed and it was decided to circulate such abstracts with the notices calling each meeting. Various other means of making the meetings of more general interest to members were considered and it was decided to arrange exhibits of specimens in addition to those shown in illustration of papers.

Year of Election.

1913 Rogers, Austin Flint, A.M., Ph.D. *Professor of Mineralogy and Petrography. Leland Stanford Junior University, Palo Alto, California, U.S.A.*

1902 Russell, Arthur Edward Ian Montagu, M.B.E. *Swallowfield Park, Reading, Berkshire.*

1929 Sampson, Edward, C.B., M.Sc., D.Sc. *Associate Professor of Economic Geology, Princeton University, Guyot Hall, Princeton, New Jersey, U.S.A.*

1931 Schaller, John Frank, M.S., Ph.D. *Geophysical Laboratory, 2801 Upton Street, Washington, D.C., U.S.A.*

1912 Schaller, Waldemar Theodore, Ph.D. *United States Geological Survey, Washington, D.C., U.S.A.*

1933 Schiebmann, Karl Hermann. *Professor of Mineralogy and Petrology, Mineralogical Institute, The University, 36 Talstrasse, Leipzig, Germany.*

1919 Schoeller, Walter Raymond, Ph.D. *8 Victoria Avenue, Bishopsgate, London, E.C. 2.*

1920 Schoep, Alfred, D.Sc. *Professor of Crystallography and Mineralogy in the University of Gent, 6 Rue de la Roseraie, Gent, Belgium.*

1928 Scholtz, Douglas Leinster, M.Sc. *Lecturer in Geology, Transvaal University College, Pretoria, Transvaal, South Africa.*

1914 Scott, Alexander, M.A., D.Sc. *'Conway House', Albert Terrace, Wolstanton, Stoke-on-Trent, Staffordshire.*

1932 Scrivenor, John Brooke, I.S.O., M.A., F.G.S., *68 Chaucer Road, Bedford.*

1933 Seto, Kunikatsu, *Assistant Professor. Tohoku Imperial University, Sendai, Japan.*

1908 Shand, Samuel James, D.Sc., Ph.D., F.G.S. *Professor of Geology, University of Stellenbosch, South Africa.*

1932 Silberrad, Charles Arthur, B.A., B.Sc. *2 Forest Side, Epping, Essex.*

1912 Simpson, Edward Sydney, D.Sc., B.E., F.C.S. *Government Mineralogist and Chemist, Western Australia. 'Carlingford', Mill Point, South Perth, Western Australia.*

1897 Smith, George Frederick Herbert, M.A., D.Sc., F.G.S., F.R.A.S. *British Museum of Natural History, South Kensington, London, S.W. 7.*

	Year of Election.	
A	1911	Smith, Herbert Gladstone, B.Sc., A.R.C.S., F.G.S. Reader in Geology in the University of London, *Queen Mary College, Mile End Road, London, E.* 1.
L	1910	Smith, Walter Campbell, M.C., T.D., M.A., F.G.S. *Mineral Dept., British Museum of Natural History, South Kensington, London, S.W.* 7.
A	1933	Smythe, John Armstrong, D.Sc., Ph.D. Lecturer in Metallurgy, *Armstrong College, Newcastle-on-Tyne;* and 10 *Queen's Gardens, Benton, Forest Hall, Northumberland.*
A	1929	Solignac, Marcel Jean Louis, D. ès Sc. Chef du Service Géologique de Tunisie, 12 *Rue Émile Duclaux, Tunis.*
A	1925	Spencer, Edmondson, Ph.D., D.Sc., A.R.S.M., F.I.C., F.G.S. *c/o Messrs. Bird & Co.* (*Research Dept.*), *Post Box* 46, *Calcutta, India.*
A	1894	Spencer, Leonard James, C.B.E., M.A., Sc.D., F.R.S. Keeper of Minerals in the British Museum, *Mineral Dept., British Museum of Natural History, South Kensington, London, S.W.* 7.
A	1928	Spiller, Reginald Charles, M.A. Demonstrator in Mineralogy, *Dept. of Mineralogy, University Museum, Oxford.*
A	1923	Stillwell, Frank Leslie, D.Sc. 44 *Elphin Grove, Hawthorne, Victoria, Australia.*
A	1923	Stockley, Gordon Murray, A.R.C.S., A.I.C., F.G.S. *Geological Survey Dept., Dodoma, Tanganyika Territory, East Africa.*
A	1926	Stuart, Alan, M.Sc., F.G.S. 32 *Gwydr Crescent, Uplands, Swansea, South Wales.*
A	1928	Sweet, Miss Jessie May, B.Sc. *Mineral Dept., British Museum of Natural History, South Kensington, London, S.W.* 7.
A	1925	Tarr, William Arthur, B.Sc., B.S., Ph.D. Professor of Geology and Mineralogy, University of Missouri. 704 *Westwood Avenue, Columbia, Missouri, U.S.A.*
A	1922	Taylor, Joseph Cornelius. 440 B *Watford Way, London, N.W.* 7.

Year of Election.

A 1903 Thomas, Herbert Henry, M.A., Sc.D., F.R.S. Petrographer to the Geological Survey of Great Britain. *Geological Survey and Museum, Exhibition Road, South Kensington, London, S.W. 7.*

A 1931 Thomas, John Herbert, *Penarth, Truro, Cornwall.*

A 1925 Thomson, Ellis, B.A.Sc. Assistant-Professor, *Dept. of Mineralogy, University of Toronto, Canada.*

A 1921 Tilley, Cecil Edgar, B.Sc., Ph.D., A.I.C., F.G.S. Professor of Mineralogy and Petrology, *Dept. of Mineralogy and Petrology, Cambridge.*

A 1925 Tomkeieff, Sergei Ivanovich, F.G.S. *Geology Dept., Armstrong College, Newcastle-on-Tyne.*

L 1927 Trechmann, Charles Taylor, D.Sc., F.G.S., F.Z.S. *'Hudworth Tower', Castle Eden, Co. Durham.*

A 1923 Tsuboi, Seitarō. *Geological Institute, College of Science, Imperial University, Tokyo, Japan.*

L 1920 Tunbridge, Edward William, B.Sc., F.G.S. *'Westbury', Lillington, Leamington Spa, Warwickshire.*

L 1891 Tutton, Alfred Edwin Howard, M.A., D.Sc., F.R.S. *Yew Arch, Dallington, Sussex.*

A 1933 Vaux, George, B.S., F.R.G.S. *'The Thicket', Bryn Mawr, Pennsylvania, U.S.A.*

A 1925 Vendl, Aladár, Ph.D. Professor in the Technical High School, *Rezeda utca 7, Budapest I, Hungary.*

A 1925 Vendl, Miklós, Ph.D. Professor of Mineralogy and Geology, *Mining Academy, Sopron, Hungary.*

A 1930 Vickers, Arthur Eric Jarvis, M.Sc, F.I.C., F.G.S. *'Hazeldene', Junction Road, Norton-on-Tees, Co. Durham.*

A 1930 Wager, Lawrence Rickard, B.A., B.Sc., F.G.S. *Dept. of Geology, University of Reading, Reading, Berkshire.*

L 1930 Walker, Frederick, M.A., Ph.D., D.Sc., F.R.S.E., F.G.S. *Dept. of Geology, The University, St. Andrews, Fife.*

A 1913 Walker, Thomas Leonard, M.A., Ph.D., F.G.S. Director of the Royal Ontario Museum of Mineralogy, and Professor of Mineralogy and Petrography in the *University of Toronto, Canada.*

	Year of Election.	
A	1923	Watson, John Adam, A.C.G.I., F.I.C., F.C.S. 26 *Thorburn Road, Colinton, Edinburgh.*
L	1894	Watts, William Whitehead, M.A., M.Sc., Sc.D., LL.D., F.R.S. Emeritus Professor of Geology in the Imperial College of Science and Technology, London. *'Hillside', Langley Park Road, Sutton, Surrey.*
A	1929	Wayland, Edward James, A.R.C.S., M.I.M.M., F.G.S. Director of the *Geological Survey of Uganda, Entebbe, Uganda, East Africa.*
A	1929	Weber, Leonhard, Ph.D. Professor of Mineralogy in the University, *Institut de Minéralogie, Université, Fribourg, Switzerland.*
A	1929	Wells, Alfred Kingsley, D.Sc., F.G.S. Reader in Geology at King's College, London. *'Holmsdale', Buckhurst Hill, Essex.*
A	1929	West, William Dixon, M.A. *Knebworth House, Broad Oak Lane, Bexhill-on-Sea, Sussex.*
L	1901	Weston, Digby St. Aubyn Percy, Commander, Royal Navy (retired). 46 *Queen's Gate Gardens, London, S.W.* 7.
A	1924	Whitlock, Herbert Percy. *American Museum of Natural History, Central Park, New York City, U.S.A.*
A	1918	Wilcockson, William Howson, M.A., F.G.S. *Geological Dept., University of Sheffield.*
L	1925	Williams, Alpheus Fuller, B.Sc. General Manager, De Beers Consolidated Mines, Ltd. *Ver Genoeg, Muizenberg, Cape Town, South Africa.*
A	1933	Wilson, Gilbert, Ph.D., M.Sc., D.I.C., F.G.S. 16 *Earls Terrace, London, W.* 8.
A	1931	Wilson, Reginald Charles, D.Sc., F.G.S. Director of the *Geological Survey of Nigeria, Kaduna Junction, Nigeria*; and 8 *Duke's Avenue, Muswell Hill, London, N.* 10.
A	1934	Wiseman, John Dugdale Holt, M.A., Ph.D., F.G.S. *Trinity Hall, Cambridge.*

Year of Election.

1927 Wooldridge, Sidney William, D.Sc., F.G.S. 7 *Shrewsbury Avenue, East Sheen, London, S.W.* 14.

1927 Wooster, William Alfred, M.A., Ph.D. Demonstrator in Mineralogy in the University of Cambridge. *Peterhouse, Cambridge.*

1919 Worth, Richard Hansford, M.Inst.C.E., F.G.S. 32 *Thornhill Road, Plymouth.*

1923 Wright, Frederic Eugene, Ph.D. *Geophysical Laboratory,* 2801 *Upton Street, Washington, D.C., U.S.A.*

PROCEEDINGS
OF THE
MINERALOGICAL SOCIETY

EXCERPT MINUTES OF COUNCIL MEETING.

Held in the Apartments of the Geological Society, Burlington House, London, W., January 25, 1934, *at* 4.15 *p.m.*

Sir THOMAS H. HOLLAND, F.R.S., President, in the Chair.

The death on January 7 of Dr. H. S. Washington was announced, and the Foreign Secretary was asked to send a letter of condolence to the Geophysical Laboratory, Carnegie Institution of Washington.

The Treasurer reported on the financial position of the Society and presented the audited accounts and Balance Sheet for the year 1933, which were adopted (vol. 23, pp. lxii–lxv). He reported that as Dr. W. R. Jones had not been able to attend the audit, he had, with the President's consent, asked Dr. L. Hawkes to act in place of Dr. Jones. This was approved.

The names of three members one year in arrear with their subscriptions, and two members two years in arrear, were reported.

It was decided to change the dates of the meetings for June and November from June 14 and November 8 to June 7 and November 1 respectively. It was further decided to arrange the dates of meetings for 1935 at the November Council Meeting instead of in June as previously done.

Letters were received from the two recently elected Honorary Members, Prof. V. M. Goldschmidt and Prof. P. Niggli.

GENERAL MEETING.

Held in the Apartments of the Geological Society, Burlington House, London, W., January 25, 1934, *at* 5.30 *p.m.*

Sir THOMAS H. HOLLAND, F.R.S., President, in the Chair.

Twenty-seven Members and three Visitors were present.

Mr. A. T. J. Dollar exhibited specimens of bent and twisted quartz crystals from Lundy Island.

Prof. C. E. Tilley exhibited specimens and microscope slides of the new mineral hydrocalumite from Scawt Hill, Co. Antrim (vol. 23, p. 607).

The following papers were read and discussed :—

1. Zoning in plagioclase felspar : by Dr. James Phemister (read by Dr. T. C. Phemister) (vol. 23, p. 541).

2. On zoned associations of antigorite, talc, actinolite, chlorite, and biotite in Unst, Shetland Islands : by Prof. H. H. Read (vol. 23, p. 519).

3. Studies on the zeolites. Part VII. 'Clinoptilolite', a silica-rich variety of heulandite : by Mr. M. H. Hey and Mr. F. A. Bannister (vol. 23, p. 556).

4. Notes on cordierite in the Dartmoor granite : by Mr. B. Rama Rao (communicated by Dr. A. Brammall).

EXCERPT MINUTES OF COUNCIL MEETING.

Held in the Apartments of the Geological Society, Burlington House, London, W., March 15, 1934, *at* 4.30 *p.m.*

Mr. Arthur Russell, Vice-President, in the Chair.

The deaths were reported of Mr. William Barlow, past-President, on February 28, and of Mr. William Greswolde Williams Sandison on January 18.

Dr. John Dugdale Holt Wiseman was provisionally elected an Ordinary Member of the Society.

The filling of vacancies in the list of Honorary Members was discussed and it was decided to consider this again at the June Meeting.

GENERAL MEETING.

Held in the Apartments of the Geological Society, Burlington House, London, W., March 15, 1934, *at* 5.30 *p.m.*

Mr. Arthur Russell, Vice-President, in the Chair.

Thirty-two Members and five Visitors were present.

The election of Dr. J. D. H. Wiseman as an Ordinary Member of the Society was confirmed.

The following papers were then read :—

1. Baryte crystals from the Manvers Main colliery, Wath-on-Dearne, near Rotherham, Yorkshire : by Mr. Arthur Russell.

2. The conditions for the crystallization of hornblende in igneous rocks : by Dr. W. Q. Kennedy.

3. An account of British mineral collectors and dealers in the 17th, 18th, and 19th centuries (continued) : by Mr. Arthur Russell.

4. On the advantages of the face-adjustment for two-circle goniometry: by Mr. M. H. Hey (vol. 23, p. 560).

The following papers were taken as read:—

1. An improved method of crystallographic computations: by Mr. M. H. Hey.

2. On face- and zone-symbols referred to hexagonal axes: a correction: by Mr. M. H. Hey.

EXCERPT MINUTES OF COUNCIL MEETING.

Held in the Apartments of the Geological Society, Burlington House, London, W., June 7, 1934, at 4.15 p.m.

Sir Thomas H. Holland, F.R.S., President, in the Chair.

The death of Mr. Robert Bell on April 12 was announced. Prof. William Noel Benson was provisionally elected an Ordinary Member of the Society.

The list of Officers and Members of Council was considered, and it was decided that the following four Ordinary Members of Council would retire: Prof. C. E. Tilley, Mr. F. A. Bannister, Dr. W. R. Jones, and Dr. F. C. Phillips; and in their place the following were proposed for submission to the Society: previous Members of Council—Prof. A. Brammall and Dr. H. H. Thomas; new Members—Mr. C. W. Mathews and Dr. T. C. Phemister.

The list of Honorary Members was considered. It was decided to fill one vacancy, and as a result of the ballot Prof. A. E. Fersman was elected subject to confirmation by the General Meeting.

A letter was received from the Edinburgh Geological Society asking for a representative of the Society to attend the centenary celebrations in Edinburgh on September 3 and 4. The General Secretary was appointed as the Mineralogical Society's representative.

GENERAL MEETING.

Held in the Apartments of the Geological Society, Burlington House, London, W., June 7, 1934, at 5.30 p.m.

Sir Thomas H. Holland, F.R.S., President, in the Chair.

Twenty-nine Members and one Visitor were present.

The election of Prof W. N. Benson as an Ordinary Member of the Society was confirmed.

On behalf of Mr. E. J. Wayland, Dr. L. J. Spencer exhibited crystals of alluvial gold from the Ankole district, Uganda.

The following papers were read:—

1. The form relations of the lead oxychlorides, laurionite, paralaurionite, and fiedlerite: by Prof. Charles Palache (read by Dr. L. J. Spencer) (vol. 23, p. 573).

2. The crystal-structure and optical properties of matlockite (PbFCl): by Mr. F. A. Bannister (vol. 23, p. 587).

3. Berthierite from Kisbánya, Carpathians: by Dr. V. Zsivny and Dr. L. Zombory (communicated by Dr. L. J. Spencer) (vol. 23, p. 566).

4. Beryllium minerals (euclase and phenakite) from Africa: by Dr. L. J. Spencer (vol. 23, p. 616).

5. Lusakite, a cobalt-bearing silicate from Northern Rhodesia: by Mr. A. C. Skerl and Mr. F. A. Bannister (vol. 23, p. 598).

6. The determination of small amounts of copper in rocks: by Dr. A. W. Groves (vol. 24, p. 35).

7. Thirteenth list of new mineral names: by Dr. L. J. Spencer (vol. 23, p. 624).

8. A new meteoric stone from Silverton, New South Wales: by L. J. Spencer (vol. 23, p. 569).

9. Studies on the zeolites. Part VIII. A theory of the vapour-pressure of zeolites: by Mr. M. H. Hey.

EXCERPT MINUTES OF COUNCIL MEETING.

Held in the Apartments of the Geological Society, Burlington House, London, W., November 1, 1934, *at* 4 *p.m.*

Sir Thomas H. Holland, F.R.S., President, in the Chair.

The resignation of Dr. B. H. Knight was received and accepted. Dr. L. Hawkes and Dr. W. R. Jones were nominated as auditors.

The draft Annual Report was read and after amendment approved.

A proposal to print brief abstracts of papers to be read at the meetings was discussed and it was decided to circulate such abstracts with the notices calling each meeting. Various other means of making the meetings of more general interest to members were considered and it was decided to arrange exhibits of specimens in addition to those shown in illustration of papers.

GENERAL (ANNIVERSARY) MEETING.

Held in the Apartments of the Geological Society, Burlington House, London, W., November 1, 1934, *at* 5.30 *p.m.*

Sir THOMAS H. HOLLAND, F.R.S., President, in the Chair.

Thirty-two Members and three Visitors were present.

The chairman nominated Mr. A. R. Alderman and Dr. J. D. H. Wiseman to act as scrutineers of the voting-papers for the election of Officers and Council.

The election of Prof. Aleksandr Evgenievich Fersman of Moscow as an Ordinary Member was confirmed.

The General Secretary then read the following:—

ANNUAL REPORT OF COUNCIL FOR 1934.

During the session 1933–34 four ordinary meetings have been held. Twenty-three papers have been read and four were taken as read. Four numbers (143–146) of the Mineralogical Magazine have been issued containing twenty-one papers, occupying 220 pages and illustrated with 71 text-figures and 4 plates. These numbers also include 638 abstracts occupying 192 pages.

The Council regrets to announce the death of a Honorary Member, Dr. Henry Stephens Washington; a Past-President, Mr. William Barlow; and two Ordinary Members, Mr. Robert Bell and Mr. William Greswolde Williams Sandison.

Eight Ordinary Members have been elected, and Prof. Victor Moritz Goldschmidt and Prof. Paul Niggli have been elected Honorary Members, bringing the total membership on October 31, 1934, to 233 (including eight Honorary Members).

The accounts for the year ending Saturday, December 30, 1933, showed an excess of assets over liabilities of £1,151 12*s.* 11*d.*, against £1,146 10*s.* 10*d.* on December 31, 1932. These assets do not include the Library and unsold stock of publications, nor the securities and cash allocated to the Composition Fees account. The value of securities standing in the names of the Trustees on December 30, 1933 was: General Reserve £874 14*s.* 3*d.*, Composition Fees account £987 3*s.* 9*d.*, against £852 6*s.* 6*d.* and £962 16*s.* 3*d.* respectively on December 31, 1932. One Composition Fee had been received during the year, but it had not been invested when the accounts were closed.

The Society's Library has received during the year 144 parts of periodicals and 42 separate copies of papers. 22 volumes have been borrowed during the year.

The Nomenclature Committee, after its meeting on November 9, 1933, had forwarded an agreed report to the Nomenclature Committee of the Mineralogical Society of America, but no action had yet been taken on this report in America.

A memorial plaque to William Hyde Wollaston, to which this Society had contributed, was placed on Wollaston's house at 14 Buckingham Street, London, W. 1, and was unveiled on July the fourth by Sir F. Gowland Hopkins, President

of the Royal Society. The unveiling ceremony was attended by the President and General Secretary and by several other members of the Society.

The General Secretary was the official delegate of the Society at the celebration of the centenary of the Edinburgh Geological Society on September 3 and 4.

It was proposed by Mr. M. H. Hey and seconded by Dr. A. F. Hallimond that the report be adopted. This was carried unanimously.

The scrutineers reported that 44 voting papers had been returned to the General Secretary and that the list nominated by the Council had been approved. The President declared these Officers and Ordinary Members of Council elected for the ensuing year:—

President. Sir Thomas H. Holland, K.C.S.I., K.C.I.E., D.Sc., F.R.S.

Vice-Presidents. Arthur Russell, M.B.E.
Sir William H. Bragg, O.M., K.B.E., M.A., D.Sc., F.R.S.

Treasurer. F. N. Ashcroft, M.A., F.G.S., F.C.S.

General Secretary. W. Campbell Smith, M.C., T.D., M.A., F.G.S.

Foreign Secretary. Prof. A. Hutchinson, O.B.E., M.A., Ph.D., F.R.S.

Editor of the Journal. Dr. L. J. Spencer, C.B.E., M.A., Sc.D., F.R.S.

Ordinary Members of Council.

Prof. P. G. H. Boswell, O.B.E., D.Sc., A.R.C.S., F.R.S.

Prof. H. L. Bowman, M.A., D.Sc., F.G.S.

Dr. L. Hawkes, D.Sc., F.G.S.

J. B. Scrivenor, I.S.O., M.A., F.G.S.

T. Crook, A.R.C.S.I., F.G.S.

Dr. W. F. P. McLintock, D.Sc., F.G.S.

L. R. Wager, B.A., B.Sc., F.G.S.

Dr. A. K. Wells, D.Sc., F.G.S.

Prof. A. Brammall, Ph.D., D.Sc., F.G.S.

C. W. Mathews, F.G.S.

Dr. T. C. Phemister, Sc.M., Ph.D., D.Sc., F.G.S.

Dr. H. H. Thomas, M.A., Sc.D., F.R.S.

A vote of thanks to Prof. C. E. Tilley, Dr. W. R. Jones, Dr. F. C. Phillips, and Mr. F. A. Bannister, retiring Members of Council, was proposed by Dr. G. F. Herbert Smith and seconded by Sir Albert E. Kitson, and was carried unanimously.

Mr. Arthur Russell proposed a vote of thanks to the Geological Society of London for allowing the Society the free use of their rooms. This was seconded by Mr. F. A. Bannister and carried unanimously.

The following papers were then read:—

. Murnpeowie (South Australia), a granular type of meteoric
n: by Dr. L. J. Spencer (vol. 24, p. 13).

. Colour reactions in the micro-chemical determination of
erals: by Mr. J. Adam Watson (vol. 24, p. 21).

. Almandine from Botallack, Cornwall: by Mr. A. R. Alderman
l. 24, p. 42).

. The meteoric stone seen to fall in the Mangwendi native reserve,
thern Rhodesia, on March 7, 1934: by B. Lightfoot, A. M.
gregor, and E. Golding (read by Mr. H. B. Maufe) (vol. 24, p. 1).

. The crystal-structure of the bismuth oxyhalides: by Mr. F. A.
nnister.

MINERALOGICAL

ABSTRACT OF RECEIPTS AND PAYMENTS

Receipts.	£ s. d.	£ s. d.	General Pur- £ s. d.
By Balances brought forward from 1933—			
1. At Bankers:			
(*a*) Current Account	16 14 3		
(*b*) Deposit Account	220 0 0		
2. In Office	0 13 1		
		237 7 4	
Entrance Fees		4 4 0	
Annual Subscriptions—			
1. Current year	176 8 9		
2. Arrears	11 11 0		
3. Advance	2 2 0		
		190 1 9	
Sale of Publications—			
1. By Publishers, April 1, 1933–March 31, 1934. Sales at subscription rate £257 0*s.* 0*d.* and other sales £12 11*s.* 0*d.*, less trade discount and commission £68 8*s.* 8*d.*, and distribution charges £12 13*s.* 10*d.*	188 8 6		
2. By Custodian of Stock, 1934. £34 3*s.* 0*d.*, less distribution charges £1 5*s.* 9*d.* and cost of back numbers purchased £1 2*s.* 11*d.*	31 14 4		
		220 2 10	
Advertisement Fees, £32 9*s.* 9*d.*, less commission £6 9*s.* 11*d.*		25 19 10	
Interest on Investments as received—			
1. £640 3½% War Loan 1952 and after, Inscribed Stock	22 8 0		
2. £105 4% Consolidated Loan 1957, Inscribed Stock	4 4 0		
3. £100 4% Funding Loan 1960–90, Inscribed Stock	4 0 0		
		30 12 0	
Deposit Interest		2 1 9	
Small Receipts		0 0 8	
Transfers from other accounts—			
From Composition Fees Account, being Interest on Investments		34 5 6	
		£744 15 8	

OCIETY

)R THE YEAR ENDING DECEMBER 31, 1934

)SES ACCOUNT.

Payments.	£	s.	d.	£	s.	d.
Printing and distributing the Mineralogical Magazine Nos. 144–147 inclusive (Oxford University Press)—						
1. Printing	328	11	6			
2. Illustrations	28	1	0			
3. Authors' Separate Copies	24	7	0			
4. Distribution Charges	14	5	0			
				395	4	6
Printing and distributing Notices of Meetings and other annual miscellaneous printing				16	8	0
Miscellaneous Printing, &c. (not annual)—						
1. Receipt Books (renewal of stock)	2	14	6			
2. Notices *re* the Jubilee Meeting of the Geological Society of Switzerland	0	18	6			
				3	13	0
Expenses at Meetings—						
1. Hire of Lantern	1	11	0			
2. Operator of lantern	1	11	6			
3. Porter	1	0	0			
4. Tea	2	15	6			
				6	18	0
Care of Stock of Publications, J. Mugford, Annual Fee				1	1	0
Editor's Honorarium				50	0	0
Librarian's Honorarium				5	0	0
Postage—						
1. Hon. Secretary	1	0	8			
2. Editor	0	13	6			
3. Librarian	0	1	1			
4. Hon. Treasurer (not charged)	0	0	0			
				1	15	3
Bank charges and other small items				0	6	10
Investments, purchase of £50 8*s.* 0*d.* Metropolitan Water Board 'B' Stock Inscribed				50	0	8
Balance, December 31, 1934—						
1. At Bankers:						
(*a*) Current Account	14	1	0			
(*b*) Deposit Account	200	0	0			
2. In Office	0	7	5			
				214	8	5
				£744	15	8

Examined and compared with vouchers and found correct.

L. HAWKES
W. R. JONES } Auditors.

January 11, 1935.

F. N. ASHCROFT, Hon. Treasurer.

BALANCE

DECEMBER

LIABILITIES.	£	s.	d.	£	s.	d.
To Annual Subscriptions received in advance—						
1. Received in 1933 for 1935	1	1	0			
2. Received in 1934 for 1935	2	2	0			
				3	3	0
Excess of Assets over Liabilities				1247	10	4
				£1250	13	4

COMPOSITION FEES ACCOUNT

RECEIPTS.	£	s.	d.	£	s.	d.
By Composition Fees received as per last Account .	1139	5	0			
Composition Fees received during year . .	10	10	0			
				1149	15	0
Income—						
Interest on Investments as received:						
1. £975 3½% War Loan 1952 and after, Inscribed Stock	34	2	6			
2. £10 4s. 8d. 3% Conversion Loan 1948–53, Inscribed Stock	0	3	0			
				34	5	6
				£1184	0	6

HEET

. 1934.

Assets.	£ s. d.	£ s. d.
Balances—		
General Purposes Account:		
1. At Bankers:		
(*a*) Current Account	14 1 0	
(*b*) Deposit Account	200 0 0	
2. In Office	0 7 5	
		214 8 5
Sundry Debtors—		
1. Publishers (Oxford University Press):		
(*a*) For sales of Publications, April 1–Dec. 31 1934	30 15 9	
(*b*) For advertisement Fees, April 1–Dec. 31. 1934	13 5 6	
2. For other sales	0 1 0	
		44 2 3
Investments at Broker's Valuation—		
1. £640 3½ % War Loan 1952 and after, Inscribed Stock at 108¾ %	696 0 0	
2. £105 4 % Consolidated Loan 1957, Inscribed Stock at 117¾ % ex div.	123 12 9	
3. £100 4 % Funding Loan 1960–90, Inscribed Stock at 120½ %	120 10 0	
4. £50 8*s.* 0*d.* 3 % Metropolitan Water Board 'B' Stock, Inscribed, at 99 %	49 17 11	
		990 0 8
Annual Subscriptions in Arrear, £3 6*s.* 0*d.*, estimated to realize		2 2 0
		£1250 13 4

NOTE.—The value of the Library, that of the unsold Stock of Publications and the Securities allocated to the Composition Fees Account are not included in the above assets.

January 17, 1935. F. N. ASHCROFT, Hon. Treasurer.

EAR ENDING DECEMBER 31, 1934.

Payments.	£ s. d.	£ s. d.
Investments as per last Account—		
£975 3½ % War Loan 1952 and after, Inscribed Stock valued by Brokers at £1060 6*s.* 3*d.* (108¾ %) at cost	1128 15 0	
Investments made during year—		
£10 4*s.* 8*d.* 3 % Conversion Loan 1948–53, Inscribed Stock, valued by Brokers at £10 16*s.* 5*d.* (105¾ %), at cost	10 10 0	
£10 12*s.* 0*d.* 3 % Metropolitan Water Board 'B' Stock, Inscribed, valued by Brokers at £10 9*s.* 11*d.* (99 %), at cost	10 10 0	
		1149 15 0
Income transferred to General Purposes Account		34 5 6
		£1184 0 6

Examined and compared with Vouchers and found correct.

L. HAWKES
W. R. JONES } Auditors.

January 11, 1935. F. N. ASHCROFT, Hon. Treasurer.

THE MINERALOGICAL MAGAZINE
AND
JOURNAL OF
THE MINERALOGICAL SOCIETY

No. 148 March, 1935 Vol. XXIV

The meteoric stone seen to fall in the Mangwendi native reserve, Southern Rhodesia, on March 7, 1934.

By B. Lightfoot, M.C., M.A., F.G.S., Director,
A. M. Macgregor, M.A., F.G.S., and E. Golding, A.I.M.M.
Geological Survey of Southern Rhodesia.

[Read November 1, 1934.]

1. *Circumstances of the fall.*[1]

THIS is the first meteorite to be recorded from either Southern or Northern Rhodesia. It fell at about 12.45 p.m. on March 7, 1934, on the right bank of the Shawanoya river in the Mangwendi native reserve, about forty miles east of Salisbury. The latitude and longitude of the spot are 17° 39′ S., 31° 36′ E.

The recovery of the meteorite was made through the efforts of the Rev. F. J. Gits, S.J., who is in charge of St. Paul's Mission. Three loud detonations were heard from a direction north-east of the Mission Station followed by a loud rushing sound. Father Gits, who was out in the open at the time, involuntarily ducked his head. His inquiries failed at first to elucidate the cause of the explosions, which were also heard at Arcturus, Macheke, and Mtoko, that is, over a radius of at least fifty miles. But on March 21 a native came and told of a 'maminimini', meaning 'something to make you gape', that had terrified the people of the district and which they feared to talk about. He said 'a sun came rushing from the sky and buried itself in the earth'. Father Gits proceeded to the spot, a distance of eight miles NNE. of the Mission Station, and saw what he assumed to be

[1] Accounts were published in the Rhodesia Herald (Salisbury) of March 30, and in several South African newspapers; also in Nature (London), 1934, vol. 134, p. 469.

a meteorite, and he at once communicated with the Meteorological Department. His letter was forwarded to the Geological Survey, and Mr. B. Lightfoot visited the place in company with Father Gits. The native, Hakata by name, was persuaded to repeat his story. He said that he was guarding his lands from baboons when the meteorite descended white-hot and with a rushing noise. It came steeply down from a southerly direction and he saw it fall. It fell through a tree, cutting off branches and striking the trunk, and then penetrating the ground, which is thickly strewn with granite boulders. It had not been disturbed when seen by Mr. Lightfoot on March 27. The hole was reminiscent of a crater produced by a 'whizz-bang', and was 3 feet in diameter and 18 inches deep, the top of the meteorite being six inches below ground level. In its fall it had cut through several tree roots and it had come to rest on a granite boulder (fig. 1).

Mr. W. Edwards, retired District Native Commissioner, recorded that a fireball travelling in a northerly direction was seen at Macheke, thirty-seven miles SSE. of the place of fall. A stone is said by the natives to have fallen at Magaya (about seventeen miles east of St. Paul's Mission Station), but this could not be found, or it may be kept secret by the natives, who indeed raised objections to the removal of the Mangwendi stone. The fact that three detonations were heard suggests that other stones fell, but although search has been made no others have been found.

2. *External characters.*

One large piece weighing 49 lb. 3 oz. and ten small pieces weighing 3 lb. 1 oz. were collected and taken to Salisbury. Several small pieces were missing, and the weight of the meteorite when it hit the ground must have been about 60 lb. The main mass of the stone, weighing 48 lb. 11 oz., has been very generously presented by the Government of Southern Rhodesia to the British Museum.[1]

[1] This fine specimen is the fifth largest stone preserved in the collection, which now includes the following single stones of over 20 kg.

	Fell.	Grams.	Lb.	B.M. Reg. no.
Parnallee, Madras	Feb. 28, 1857	60,550	133½	34792
Warbreccan, Queensland ...	found 1904	31,593	69½	1905,377
,, ,, ...	,,	29,140	64	1905,378
Kyushu, Japan	Oct. 26, 1886	28,803	63½	80031
Mangwendi, Rhodesia ...	March 7, 1934	22,084	48¾	1934,839
Wold Cottage, England ...	Dec. 13, 1795	20,638	45½	1073

The stone has the form of a roughly rectangular block measuring proximately 24 × 22 × 18 cm. Five sides are covered with a black ust with a maximum thickness of 0·8 mm. A striking feature is esented by the channelled grooves on the edges of the three crusted rfaces adjacent to the back of the stone (fig. 2). 'Thumb-mark'

Fig. 1. Meteoric stone of Mangwendi, Southern Rhodesia. Seen in situ in front of the shovel.

tings are seen on one side (fig. 3) towards the front of the stone, d there are also a few at the back of the stone, but they are not ominent. The crust shows fine radiating stream-lines resembling e paint marks left by a brush, but there is no cascade of fused aterial over the back edges of the stone. Stream-lines are also seen the back surface. Small grains of nickel-iron project through the ust in places.

The sixth surface of the block is broken and approximately flat th a slabby fracture. Parallel to this direction there are fresh acks (shown on the back surface in fig. 2) formed by fracturing en the stone fell. A step shown on the large side surface in fig. 2 ggests that a slabby piece had broken away before the crust was

formed. The most prominent 'thumb-marks' are in the angle of this step. The stone thus appears to have a slabby structure.

FIG. 2. Meteoric stone of Mangwendi, Southern Rhodesia. The surface to the left is the back of the stone. ½ actual size.

For the purpose of the above brief description in conjunction with figs. 2 and 3, mention has been made of the 'front' and 'back' of the stone. But it must be pointed out that there is no clear evidence for this orientation. In fact, what is now described as the 'front' has been thought by some persons to be the 'back'. The lines of

ow on the surface of the crust do not radiate uniformly from one ntre, and the positions of the pittings are inconclusive.

Fig. 3. Meteoric stone of Mangwendi, Southern Rhodesia. View from the front of the stone. ½ actual size.

3. *Petrographical description* (*A.M.M.*).

The broken surface shows the stone to be fine-grained and of pale grey colour. Iron sulphide is conspicuous mainly in small veins through the stone. Specks of nickel-iron are mostly surrounded by rusty staining, due probably to the oxidation of lawrencite. The stone has a fragmental structure with angular inclusions, either lighter

or darker in colour than the matrix. One of these measures 4·5 × 4·5 cm., but the majority are 1 cm. or less in diameter. Spheroidal chondrules are not conspicuous even under a hand-lens.

Four microscope sections have been cut by Mr. N. E. Barlow from fragments of the stone. Owing to its rather friable nature the material was soaked in fused Canada balsam before grinding. In the slides the chondritic structure as well as the fragmental nature of the stone are evident, and chondrules are present both in the angular inclusions and in the surrounding matrix. One triangular mass about 4 mm. in length, which differs from the matrix by being darker in colour due to more abundant fine opaque matter, mainly troilite or pyrrhotine, contains one complete chondrule and the broken fragment of another. Other fragmental inclusions differ from the matrix by being either finer or coarser in grain or may be composed of single crystals of colourless hypersthene. Some have outlines suggesting the form of pyroxene crystals, but are composed of a mosaic of small crystals, suggesting recrystallization under metamorphism.

The chondrules occur as complete spheroids or as broken fragments, and vary considerably in size, in grain, and in structure; the largest exceed 2 mm. in diameter. Some resemble cloudy devitrified glass, in which shadowy crystals of pyroxene, which fade at the margins, one into another, are visible in cross-polarized light. The only iron-ore in these may be in cracks which extend into the matrix. The majority of the chondrules have a seemingly fibrous structure which is either parallel or radiating. Some may consist of a single crystal of pyroxene, clear at the margin, but containing in the interior a parallel intergrowth of another mineral which appears to be felspar with an extinction-angle of about 45° from the direction of the fibres. The majority of the radiating intergrowths cannot be resolved.

The matrix of the stone is wholly crystalline, being an aggregate of granules without recognizable crystal forms, but the felspar and pyrrhotine are usually interstitial. The grain varies as much from part to part as do the fragmental inclusions, of which it is sometimes difficult to distinguish a margin.

Olivine and pyroxene, not always easy to recognize, form the bulk of the stone. Both are optically negative and therefore relatively rich in iron, though they are quite colourless.

Two felspars can be distinguished. The most abundant shows a high relief against the balsam. It is untwinned and the cleavage is generally indistinct. It is optically negative with large axial angle.

hese characters are in agreement with labradorite-bytownite as etermined in the analysis. Orthoclase is scattered in interstices. An real analysis with the Shand micrometer gave a value of 0·6 % for e latter in one slide.

Three opaque substances are recognizable in the slides. Nickel-on forms small pellets, often rounded in shape but sometimes regular, with partially concave outlines. In very few cases does it ppear to be moulded against silicate minerals, but it may enclose hromite partially or wholly. The slides are generally stained brown ear the metal, suggesting the presence of lawrencite (ferrous hloride). A sulphide of iron, troilite or pyrrhotine, is rather entiful in the silicate portion of the rock, where it is frequently terstitial and fills small cracks. Since it is almost non-magnetic is probably troilite.

The third opaque substance has a dark inky-blue colour. It ppears to be a mixture of chromite and ilmenite with other opaque bstances. While some of it, probably chromite, has crystallized ery early, being enclosed in the iron, another portion, perhaps a hosphate resembling triplite, is interstitial between crystals of ivine. An areal analysis of this opaque material in two of the ides gave a volume percentage of 2·05, which compares closely with e volume percentage of hercynite, chromite, triplite, and ilmenite lculated from the analyses.

For purposes of determining the mineral composition the three nalyses were treated separately.

In the insoluble portion the alumina is almost exactly equivalent the lime and alkalis to form felspar. After deducting chromite nd ilmenite, the remaining iron and the magnesia were calculated s hypersthene and enstatite on the assumption that all the olivine ad been dissolved. A quantity of silica equivalent to 3·62 % of the hole stone was found to remain. Since the presence of free silica in stone so rich in olivine would be anomalous, and moreover could ot be determined in the slides, this silica was assumed to have been berated from the soluble portion and rendered insoluble in soda by ae evaporation to dryness.

In the soluble silicate, with the excess of silica mentioned above, nly traces of calcium and alkalis occur. The alumina probably ccurs as hercynite or Tschermak's silicate. It was calculated as the rmer. The P_2O_5 was reckoned as a phosphate of manganese and on, and the remaining bases divided between olivine and pyroxene

on the assumption that the pyroxene has the same composition as it has in the insoluble portion.

The soluble magnetic portion was calculated in the same way as the soluble silicate; and the insoluble magnetic portion was assumed to have the same composition as the insoluble silicate. Throughout the sulphur was calculated as troilite.

The resulting mineral composition is given in the following table:

Mineral Composition.

	Magnetic portion.	Insoluble silicates.	Soluble silicates.		
Orthoclase	—	0·69	—	0·69	
Albite	—	3·94	—	3·94	12·38 Felspar
Anorthite	—	7·75	—	7·75	
Enstatite	—	12·46	7·54	20·00	
Hypersthene ...	—	6·17	3·71	9·88	29·88 Pyroxene
Forsterite	0·64	—	27·15	27·79	
Fayalite	0·26	—	19·05	19·31	47·10 Olivine
Hercynite ($FeAl_2O_4$)	0·05	—	1·07	1·12	
Chromite	—	0·67	—	0·67	
Ilmenite	—	0·37	—	0·37	2·50 Iron-ore
Triplite ($Mn_3(PO_4)_2$)	—	—	0·34	0·34	
Troilite (FeS) ...	0·11	—	4·87	4·98	4·98 Troilite
Iron	2·09	—	—	2·03	
Nickel	0·93	—	—	0·93	3·07 Metal
Cobalt	0·11	—	—	0·11	
	4·19	32·05	63·73	99·91	
Lawrencite ($FeCl_2$) water soluble (including 0·06 % of iron determined in magnetic portion)				0·13	
				100·04	
Specific gravity calculated from above composition				3·51	

For purposes of comparison with other meteorites the following particulars are significant:

(1) percentage of metal ... ... 3·07
(2) ratio of iron + cobalt to nickel in metal ... ... 2·30
(3) ratio of MgO to FeO in silicate by weight ... ... 1·26
or by molecular proportion ... ... 2·22
(4) dominant felspar—bytownite-labradorite.

These characters place the stone near the boundary between roups 3 and 4 of chondrites in Prior's classification,[1] the first three haracters being characteristic of group 3 and the fourth of group 4. he stone seems to be generally similar to the Soko-Banja stone from rbia, but exhibits a further stage of progressive oxidation in every spect.

4. *Chemical analysis* (*E.G.*).

The method used for analysis was that described by George P. errill.[2] A piece of the stone weighing 18·341 grams was crushed pass 80-inch mesh. The larger particles of metal which would ot pass the sieve were pounded flat to free them from silicate as far possible and reserved. The powdered material was then worked er thoroughly with a hand-magnet, then again by an electro-agnetic separator, the magnetic portion again subjected several mes to the hand-magnet, and finally added to the metal. The whole the remaining powder was then treated by the electromagnetic parator, the attracted portion obtained worked over several times ith the hand-magnet, and added to the metal. This separation ve:

Attracted portion	... ...	0·8838
Unattracted portion	... ...	17·4558
		18·3396 grams

The attracted portion was all digested in aqua regia, evaporated dryness, taken up in hydrochloric acid, and filtered. The undis-olved portion was washed thoroughly in hot water, then digested r one hour in hot 10 % sodium carbonate solution, filtered, and the soluble residue washed thoroughly with hot water, and then with lute hydrochloric acid and again with hot water. The residue was eighed as insoluble silicate. This gave:

Dissolved	... ...	0·7636 = 4·163 % of whole
Insoluble	... ...	0·1202
		0·8838 gram

The alkaline and acid filtrates were combined, evaporated to dry-ess, and the silica separated in the usual manner. The solution was

[1] G. T. Prior, The classification of meteorites. Min. Mag., 1920, vol. 19, p. 51–63.

[2] G. P. Merrill, Bull. U.S. Nat. Mus., 1930, no. 149, pl. 57. [M.A. 4–257.]

then made up to 500 c.c. in a calibrated flask at 25° C. and divided into aliquot portions for the various determinations.

The results of analysis of the *attracted portion* were as follows:

	Grams.		4·163 % of whole.
Soluble silicate:			
SiO_2	0·0648	... ...	0·353
Al_2O_3	0·0055	... ...	0·030
TiO_2	nil	... ...	nil
FeO	0·0340	... ...	0·185
CaO	trace	... ...	trace
MgO	0·0675	... ...	0·368
MnO	0·0005	... ...	0·003
	0·1723		
Pyrrhotine (Fe_7S_8):			
Fe	0·0113	... ...	0·062
S	0·0074	... ...	0·040
	0·0187		
Metal:			
Fe	0·3878	... ...	2·114
Ni	0·1697	... ...	0·925
Co	0·0206	... ...	0·112
Cu	nil	... ...	nil
P	0·0002	... ...	0·001
	0·5783		
	0·7693		4·193

Metal found = 3·15 % of whole meteorite.

Net composition of metallic portion:

Iron, Fe	67·059
Nickel, Ni	29·345
Cobalt, Co	3·562
Phosphorus, P	0·034
Platinum metals, Pt, &c.	0·0001 (by assay 0·60 dwt. per ton)
Gold, Au	nil

Duplicate assays for 'platinoids', made by Mr. G. W. Gibbings, of the Metallurgical Department, Southern Rhodesia, gave 0·60 dwt. per short ton, corresponding with 0·0001 %. No gold was found.

The soluble silicate portion.

For the analysis of the soluble silicate triplicate portions of 2·00 grams of the finely crushed unattracted powder were taken and

ed in the same manner as the preceding attracted portion. The ge of the results were :

Dissolved	...	...	1·2564 grams
Insoluble	...	...	0·7436

er the separation of silica, the acid portions were made up to c. in a calibrated flask at 25° C. and divided into aliquot por- for the various determinations. The average of the results ned is as follows :

SiO_2	...	...	...	0·4157 grams
Al_2O_3	...	...	...	0·0131
TiO_2	...	...	...	nil
FeO	...	...	...	0·3371
CaO	...	...	...	trace
MgO	...	...	...	0·3900
MnO	...	...	...	0·0028
P_2O_5	...	...	...	0·0041
Fe	...	...	...	0·0571
S ...	...	...	...	0·0373
NiO*	...	...	...	0·0071
CoO	...	...	...	trace
				1·2643

bably present as Ni in the incompletely separated metallic portion.

The insoluble silicate portion.

m the last treatment the clean acid-washed insoluble silicate n was taken. One gram of this was weighed out, fused with m carbonate, and analysed by standard methods. The chromite ecomposed by the addition of a little potassium nitrate to the aate. The analysis gave the following results :

			Per cent.			Grams.
SiO_2	...	...	57·02	...	...	0·4240
Al_2O_3	...	...	10·35	...	...	0·0770
TiO_2	...	...	0·53	...	...	0·0039
FeO	...	...	10·37	...	...	0·0771
CaO	...	...	4·36	...	...	0·0324
MgO	...	...	13·89	...	...	0·1033
NiO	...	...	nil	...	...	nil
P_2O_5	...	...	nil	...	...	nil
Cr_2O_3	...	...	1·27	...	...	0·0094
Na_2O	...	...	1·31	...	...	0·0097
K_2O	...	...	0·32	...	...	0·0024
			99·42			0·7392

Bulk composition of the portion of the meteorite ground for analysis (Lab. No. G475).

	Attracted %	Unattracted %	Bulk Grams.	Bulk %
SiO_2	8·486	41·985	7·4440	40·590
Al_2O_3	0·720	4·505	0·7973	4·347
TiO_2	nil	0·195	0·0343	0·187
FeO	4·452	20·710	3·6740	20·033
CaO	trace	1·620	0·2847	1·553
MgO	8·840	24·665	4·4026	24·006
MnO	0·065	0·140	0·0251	0·137
P_2O_5	—	0·205	0·0360	0·196
Cr_2O_3	—	0·470	0·0726	0·450
Na_2O	—	0·485	0·0852	0·465
K_2O	—	0·120	0·0210	0·115
P	0·026	—	0·0002	0·001
NiO	—	0·355	0·0624	0·340
CoO	—	trace	trace	trace
Fe	52·265	2·855	0·9009	4·912
Ni	22·223	—	0·1697	0·923
Co	2·697	—	0·0206	0·112
Cu	nil	—	nil	nil
S	0·969	1·865	0·3352	1·827
Pt	—	—	trace	trace
Totals	100·743	100·175	18·3658	100·196
SrO	—	—	—	trace
H_2O+	—	—	—	nil
H_2O-	—	—	—	0·110
Water-soluble chlorine	—	—	—	0·071

ZrO_2, CO_2, SO_3, V_2O_3, BaO sought but not found.
Sp. gr. 3·517

Murnpeowie (*South Australia*), *a granular type of meteoric iron.*

(With Plates I–III.)

By L. J. Spencer, M.A., Sc.D., F.R.S.
Keeper of Minerals in the British Museum of Natural History.

[Read Nov. 1, 1934.]

A PRELIMINARY account of this fine mass, weighing 2520 lb., of meteoric iron was given in 1910 by L. Laybourne Smith,[1] who at that time was Registrar of the South Australian School of Mines and Industries in Adelaide; but the promised detailed description with chemical analysis never appeared. Except for a small piece cut off one corner (upper left-hand corner in fig. 1) the mass is preserved intact in the Museum of that Institution, and none of the material appears to have been distributed to other museums. Casts of the mass were, however, made for the South Australian Museum in Adelaide, and one of them was presented to the British Museum in 1917 (B.M. 1917,360), where in the meteorite collection it is a very striking object (fig. 1).

Recently, at the suggestion of Mr. R. Bedford of the Kyancutta Museum, the Council of the South Australian School of Mines has generously presented to the British Museum a piece of this meteoric iron, together with the milling cuttings, with the request that the description of it should be completed. This piece (B.M. 1934,52) weighed 875 grams (pl. I, fig. 2). Two slices were cut off the thinner end, leaving 773·5 grams with the larger cut surface of 10 × 5 cm., which was polished and etched (pl. I, figs. 3 and 4). A smaller slice (77·5 grams) was micro-polished (pl. III).

The mass was found in August 1909, and, as stated by L. L. Smith, 'on the Beltana Pastoral Company's Murnpeowie run, at a

[1] L. L. Smith, An Australian meteorite. Amer. Journ. Sci., 1910, ser. 4, vol. 30, pp. 264–266, 2 figs.

spot 29° 35′ latitude and 139° 54′ longitude, being about 16 miles N.E. by E. of Mt. Hopeless'.[1] This is north of Flinders Range and about 5 miles NW. of Lake Callabonna. There are several large areas in this region marked on the map 'Beltana Pastoral Co.' The Murnpeowie sheep run extends for a hundred miles or more, and the spot where the meteorite was found is 53 miles east of Murnpeowie head station on Twins Creek.

L. L. Smith suggested that the mass had fallen recently, and my examination of the material supports this view. It was found by some boundary-fence repairers, who used to stand on it as an 'isolated rock' when scanning the plain in search of their donkeys; and it had not been noticed when the vermin-proof fence, less than half a mile away, was erected some five years previously. Seventy yards to the west of the meteorite was a hole measuring $16\frac{1}{2} \times 12$ feet and 4 feet deep, with its greatest dimension in an E.–W. direction. Between the meteorite and the hole were two smaller indentations. L. L. Smith suggested that the meteorite travelled from the west and ricochetted on the ground before coming to rest on the surface. If this were so the horizontal component of the velocity must have been much greater than is usually the case when meteorites reach the earth's surface; but here we have an unusually large mass of iron.

In shape the mass is a thin triangular slab or wedge. The height (in the position in fig. 1) is 87 cm. and the length 120 cm. The thickness at the left-hand bottom corner is 48 cm., at the right-hand bottom corner 23 cm., and at the top 20 cm. Fig. 1 is of what L. L. Smith described as the back of the meteorite. The two figures given in his paper show the front and an end view. The pits on the back surface are rather larger than those on the front surface. On the small specimen examined (fig. 2) the surfaces are smooth and rounded, with very much the same appearance as those seen on irons that have been observed to fall. The very thin black skin is rubbed off in places, and is in part covered with a film of brown limonite. Streaks suggestive of flow are faintly shown in two places in the black skin.

[1] On the sketch-map (Min. Mag., 1932, vol. 23, p. 41) showing the distribution of South Australian meteorites this was plotted incorrectly. The spot is about 30 miles S. by W. of Carraweena. Accalana, which could not then be located, lies between the two, about 5 miles S. by W. of Carraweena. No particulars have yet been published about the Accalana and Carraweena meteorites. Casts of them were presented to the British Museum at the same time as the cast of Murnpeowie. That of Accalana (B.M. 1917,365) measures $13 \times 12 \times 10$ cm., and that of Carraweena (B.M. 1917,366) $34 \times 24 \times 17$ cm.

it· markings due to surface fusion are stated to be visible on the t surface of the main original mass. Mr. Bedford tells me that plaster cast does not do justice to the fresh appearance of the ace as shown by the original.

he internal structure shown on a polished and etched surface was

Fig. 1. Murnpeowie (South Australia) meteoric iron. Photograph of the coloured plaster cast in the British Museum. $\times\frac{1}{12}$.

rribed by Mr. L. L. Smith as brecciated. It is really granular of a very unusual type (pls. I–III). The conspicuous grains, suring up to 5 mm. across, are irregular in outline and orienta-. They show well-marked Neumann lines. A very striking ure is shown when the slice is turned about in a strong light and ections received at different angles. Three distinct areas (A, B, C gs. 3 and 4) can then be distinguished. In certain positions for a area a ghost or palimpsest structure lights up uniformly over whole of that area in the interspaces between the larger grains.

This is shown by the minute white speckles for area A in fig. 3, and for area C in fig. 4. At another inclination of the light the same is seen in area B, whilst those in A and C are extinguished.

The reflecting specks are small ragged shreds or bars up to about 1 mm. in length, and in total amount they occupy only a small proportion of the whole area. They are not recognizable under the microscope in illumination normal to the surface, but with some manipulation they can be seen with outside oblique illumination (fig. 6). Further, the effect is only shown on a more deeply etched surface: it is not seen when the finely polished and lightly etched section used for the photomicrographs (pl. III) is held in the hand and turned about in the light. In area A (where they are most easily caught) the reflections can be seen in at least five different positions of the slice, the angles between which are 30°, 60°, and 90°, as near as could be roughly estimated. These reflections must therefore be from the surfaces of etching pits parallel to the faces of the rhombic-dodecahedron (110) and the icositetrahedron (211).[1]

This curious and unusual effect is due to the presence of remnants of a previous structure when the areas A, B, C were three individual crystals in the mass. As shown in fig. 6 (magnification 8) the shreds or bars are in three directions, strongly suggesting the remnants of an octahedral lamellar structure. The areas A, B, C of the original crystals are up to 5 cm. across in the slice examined (but would no doubt be larger in a larger slice); and it must be remarked that they are much smaller than is usually the case in meteoric irons of the octahedrite type. The mass must have been subjected to a prolonged heat treatment, above 850° C. but below the melting-point, when crystal grains of γ-iron grew to an appreciable size at the expense of the α-iron. It is useless to speculate how this may have happened. Perhaps this small asteroid had been careering too near the sun.

The effect of another, and later, heat treatment is excellently shown by the Murnpeowie meteorite. This is seen in the finely granular border at the outer edge of the slice (pls. I and II), and was produced on the surface by the heat developed during the brief flight of the meteorite through the earth's atmosphere. Here again there was a transformation of α-iron to γ-iron, but only very minute crystals

[1] These faces in the etching pits of kamacite have been definitely determined by S. W. J. Smith, A. A. Dee, and J. Young, Proc. Roy. Soc. London, Ser. A. 1928, vol. 121, p. 489. [Min. Abstr., vol. 4, p. 121.]

rew in the short interval of time, followed by rapid chilling. This arply defined heating zone follows the contours of the mass, but is icker (3 mm.) on projecting corners and thinner (1 mm.) in hollows n the surface. During the flight this zone must have travelled in- ards as molten material was swept from the surface.

With the permission of Prof. Sir Harold Carpenter, F.R.S., a icroscopic examination of the iron was undertaken by Dr. J. M. obertson at the Royal School of Mines, who has kindly supplied e photomicrographs reproduced on plate III, together with the follow- g description. The identity of the reflecting portions mentioned ove is here not evident, and at present there seems to be little that n be correlated between his and my descriptions.

Microscopic examination, by Dr. J. M. Robertson.

The general structure of the slice examined resembled that obtained under tain conditions in ferrite. Two different kinds of areas could be distinguished: medium-sized crystals showing well-marked sub-boundaries and Neumann nds (figs. 7 and 8); and (*b*) large crystals in which the Neumann bands were ry distinct and the sub-boundaries very vague (figs. 9 and 10). Crystals (*a*) cupied a greater proportion of the area than (*b*).

Neumann bands are readily produced in iron and iron-nickel alloys when they e subjected to impact. They have been shown to be narrow twin bands. Sub- undaries are fairly common features of a number of metals and they have been e subject of several investigations. The ordinary or principal crystal boun- aries in metals are due to differences in orientation between adjacent crystals, hich are attacked at different rates by the etching reagent, and the surfaces of hich are at different levels after etching. The principal crystal boundaries are herefore steeply sloping steps from one crystal to another. The cause of sub- undaries is obscure, but they are not due to differences in orientation. In the resent specimen the Neumann bands crossed sub-boundaries without change in rection (figs. 9 and 10), and in other work it has been shown that there is no ange in the form of the etching pits on crossing a sub-boundary. It appears hat the sub-boundaries are lines of impurities incorporated in the crystals uring their formation. These boundaries are made evident under the microscope y the lines of etching pits that form along them. In fig. 11 sub-boundaries arked by lines of etching pits are shown.

The general conclusions that may be drawn from the structure of this meteoric on is that it consists of one constituent similar to ferrite, and that it shows eumann bands and sub-boundaries like those obtained in ferrite. It appears herefore that the nickel content is low.

The outer rim of the slice examined showed a different structure from the emainder (fig. 12). This difference in structure between the outer rim and the emainder is due to deformation of the former. The basic structure of the outer m is the same as that of the remainder, but the structure has been drastically eformed. It appears from this that the outer rim was not melted, otherwise, any nickel was present, it would show a martensitic structure. Apparently was simply heated and deformed.

Chemical analysis, by M. H. Hey.

The following results were obtained in the Museum laboratory, using 16·4 grams of the millings.

Fe.	Ni.	Co.	Cu.	Ge.	Pt.	S.	Insol.	Total.
93·88	6·32	0·32	0·002	0·007	0·07	0·006	0·20	100·80

Traces of chromium and phosphorus are also definitely present, but less than 0·005 % in amount. Gold, palladium, iridium, osmium, ruthenium, manganese, and carbon could not be detected, and if present must be less than 0·002 %. The nickel percentage is the mean of four determinations, 6·25, 6·27, 6·38, and 6·39; and that for cobalt the mean of two, 0·26 and 0·38. The relatively high percentage (0·07) of platinum, corresponding to 700 grams (22·5 ounces troy) per metric ton, is considerably higher than any previously recorded.[1] No platinum vessels were used in the course of the present analysis. The direct quantitative estimation of germanium (0·007 %) gives a rather lower value than that (0·01–0·1) given by spectroscopic methods.[2]

The method of analysis was the chlorine distillation method previously described.[3] The amount used for the main analysis was 11·4 grams, and smaller amounts were used for repeated check determinations. Platinum metals were precipitated by H_2S, separated from copper by KCNS, and weighed as metal. Palladium was shown to be absent by the dimethylglyoxime test, while the colour of the Am_2PtCl_4 precipitate indicated the absence of iridium. Special tests for other platinum metals and for gold gave negative results. Germanium was separated by distillation as $GeCl_4$ and precipitation as GeS_2; its identity was confirmed by conversion into K_2GeF_6. Owing to an accident in the collection of the whole of the $GeCl_4$ the value given is possibly rather low, but it is correct in order of magnitude.

The specific gravity determined by hydrostatic weighing on the slice weighing 17·5 grams is D^{15}_4 7·78.

Mr. Hey's chemical analysis gives an atomic ratio Fe : (Ni + Co) = 14·86 : 1, corresponding closely with the composition of kamacite, which is usually given as $Fe_{14}Ni$. The ratio of the percentage weights of iron to nickel is also 14·9, corresponding with the hexahedrite class of meteoric irons.[4] No constituent other than kamacite was detected on the section of the meteorite. On the broken edge where the slice had been sawn nearly through there is no indication of the cubic cleavage said to be characteristic (but rarely seen) of hexahedrites.

[1] Min. Abstr., vol. 1, pp. 97, 405; vol. 2, p. 34; vol. 3, p. 388; vol. 4, p. 425; vol. 5, pp. 6, 7, 13, 14, 157, 301.
[2] Ibid., vol. 5, pp. 7, 152, 402.
[3] M. H. Hey, Min. Mag., 1932, vol. 23, p. 13.
[4] G. T. Prior, Min. Mag., 1920, vol. 19, p. 57.

exahedrites and octahedrites are both cubic, and consist the first ly and the second largely of kamacite. The essential difference een them is that in octahedrites a second alloy (taenite) richer ckel has separated out parallel to the planes of the octahedron, g rise to a lamellar structure, and interrupting and rendering less conspicuous the cubic cleavage. In the coarsest octahedrites proportion of kamacite is greater and that of taenite much less, they contain correspondingly less nickel than medium and fine edrites. It is therefore probable that the original structure of Murnpeowie iron was that of a coarsest octahedrite.

Murnpeowie there are differently orientated grains of kamacite ing well-marked Neumann lines. The structure is not continuous ghout the whole mass, neither is it brecciated. This is rather e of recrystallization of the material in the solid, due to heat ment, whereby the structure of the original coarse octahedral llar structure has been changed.

s shown by F. Berwerth[1] such a change in structure can be pro- d artificially by heating, and meteorites so changed he called bolites. This term has been extended by G. P. Merrill[2] to orites showing the same structure that had not been heated cially. Metabolite and metabolism are not terms to be recom- ed in this connexion, especially as they have long been in use ochemistry. Metamorphism is more appropriate; still more so morphism, since only a change from one modification of iron another (polymorphic) modification is involved. It is probable many ataxites and granular hexahedrites and octahedrites owe structure to the effects of a later heat treatment.

ie same change is shown on a smaller scale in the external heating of meteoric irons that have been observed to fall (e.g. Braunau, lotte, Rowton) and in some others that are evidently of recent e.g. Bingera, Signal Mountain, San Francisco Mountains[3]); though gely there are some such irons in which it is not evident (e.g. galdi). It was first figured for Braunau by W. Haidinger[4] in 1855,

. Berwerth, Künstlicher Metabolit. Sitzungsber. Akad. Wiss. Wien, Math.- wiss. Kl., Abt. 1, 1905, vol. 114, pp. 343–356.

. P. Merrill, A meteoric metabolite from Dungannon, Virginia. Proc. U.S. Mus., 1923, vol. 62, art. 18. [Min. Abstr., vol. 2, p. 161.]

. H. Perry, Amer. Journ. Sci., 1934, ser. 5, vol. 28, pp. 214–217. [Min. ., vol. 6, p. 13.]

V. Haidinger, Sitzungsber. Akad. Wiss. Wien, 1855, vol. 15, pl. 1, fig. 5.

and attention was specially drawn to it by Baron Reichenbach [1] in 1862. I have previously stated that it is not shown by any of the irons from the meteorite craters at Henbury in Central Australia.[2] Mr. R. Bedford has, however, since sent a slice in which this is shown very clearly, suggesting that Henbury also was a recent fall. Evidently the whole matter requires further study.

Explanation of Plates I–III.

Meteoric iron of Murnpeowie, South Australia.

(Photographs, figs. 1–5, by H. G. Herring; fig. 6, by Dr. J. B. Knight; photomicrographs, figs. 7–12, by Dr. J. M. Robertson.)

Fig. 1 in the text (p. 15).

Plate I, Fig. 2. External surface of the British Museum specimen (B.M. 1934,52). Actual size.

—— Figs. 3 and 4. Polished and etched surface (B.M. 1934,52), photographed in different illuminations. Showing granular structure in three areas, A, B, C. Fig. 3 shows a ghost structure uniformly over the area A, and fig. 4 a similar structure in the area C. At a third inclination of the light a similar structure is shown in the area B. Actual size.

Plate II, Fig. 5. Upper part of area A of figs. 3 and 4. Showing the granular structure with Neumann lines in the larger grains, and the outer heating zone. ×8.

—— Fig. 6. Same area as in fig. 5 in oblique illumination, showing remnants of the previous octahedral lamellar structure. ×8.

Plate III, Figs. 7 and 8. Area of smaller crystals showing well-marked sub-boundaries and Neumann lines. ×100.

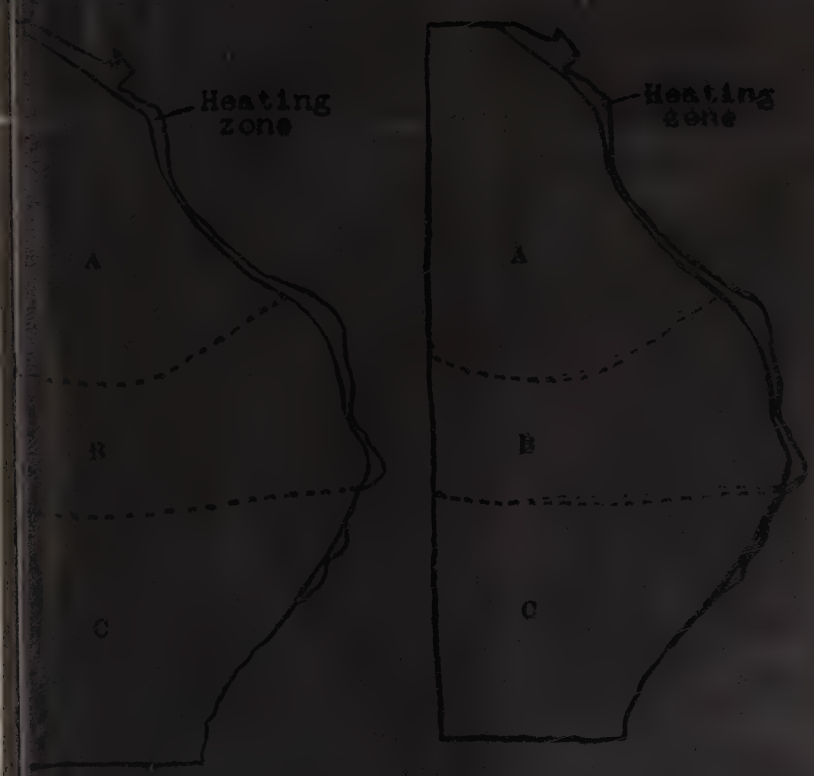
—— Figs. 9 and 10. Area of larger crystals, showing well-marked Neumann lines and less distinct sub-boundaries. In fig. 9 a single crystal occupies the whole area. ×100.

—— Fig. 11. Lines of etching pits marking the sub-boundaries. The dark line is an ordinary crystal boundary. ×840.

—— Fig. 12. The outer heating zone of the meteorite. ×840.

[1] K. L. von Reichenbach, Ann. Phys. Chem. (Poggendorff), 1862, vol. 115, pp. 155–156. Compare E. Cohen, Meteoritenkunde. Stuttgart, 1894, Heft 1, pp. 72–73.

[2] L. J. Spencer, Min. Mag., 1933, vol. 23, p. 389; Nature, London, 1934, vol. 133. p. 576.


Heating zone
A
B
C
Heating zone
A
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Heating
zone
A
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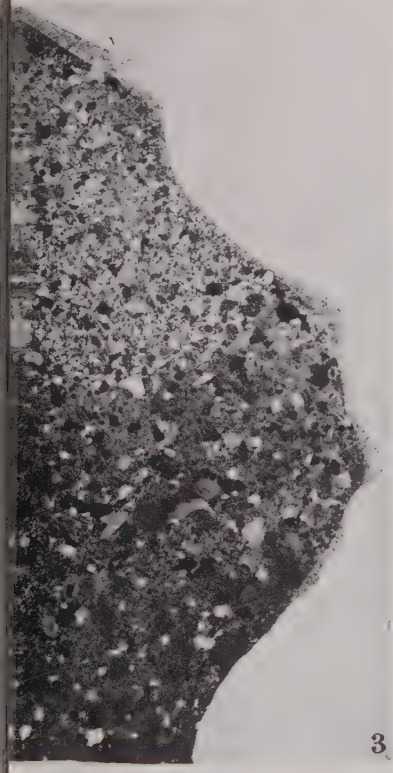
2



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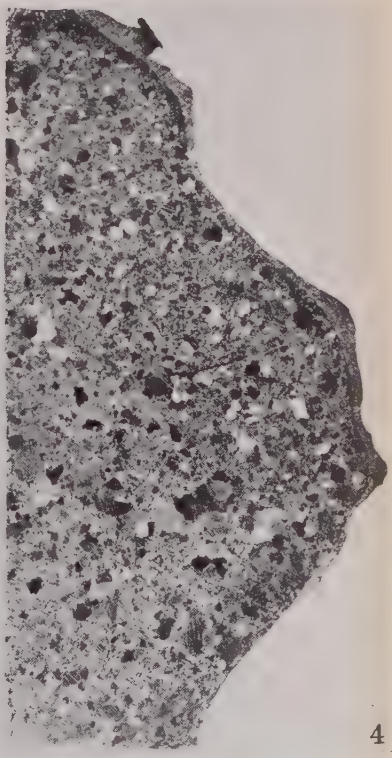

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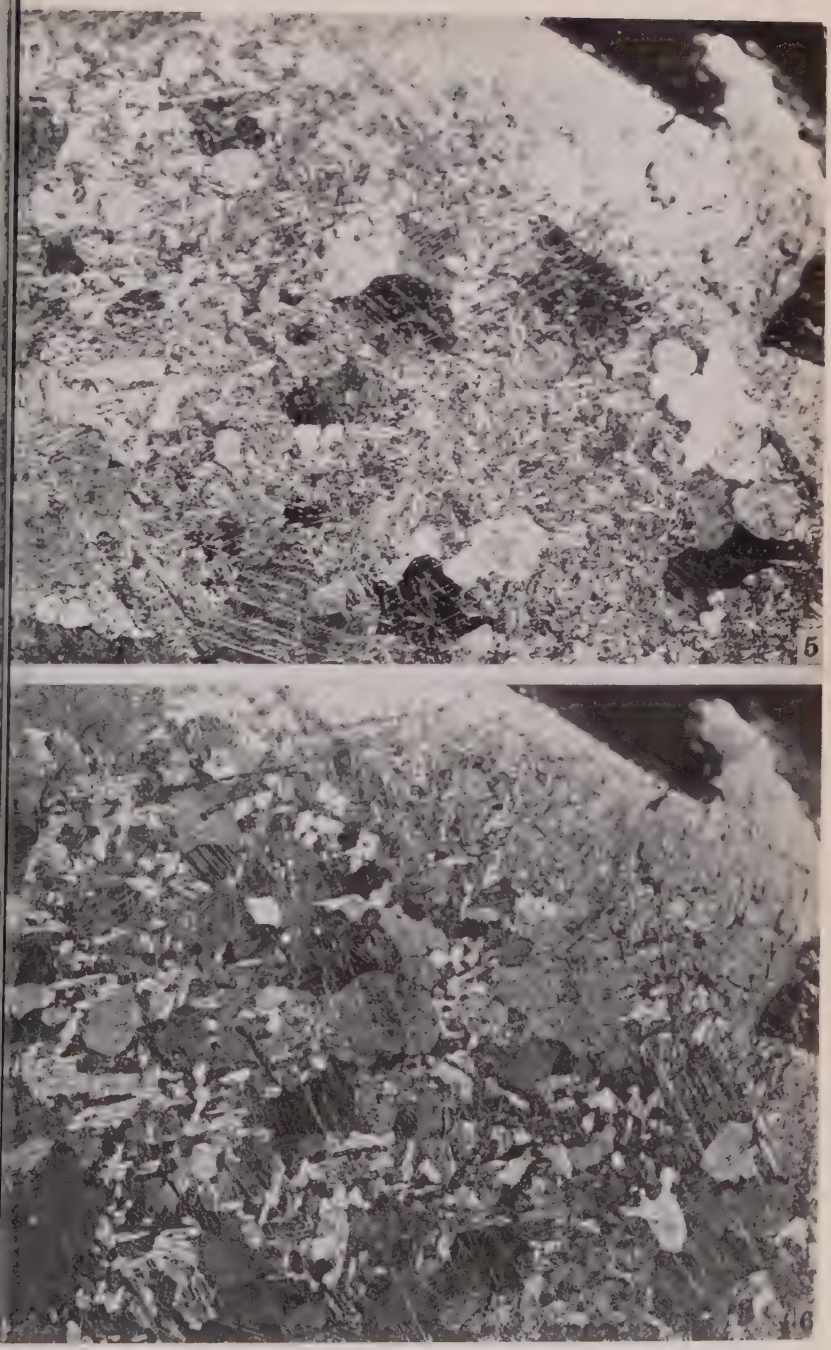
L. J. Spencer; Murnpeowie Meteoric Iron



L. J. Spencer: Murpenowie Meteoric Iron

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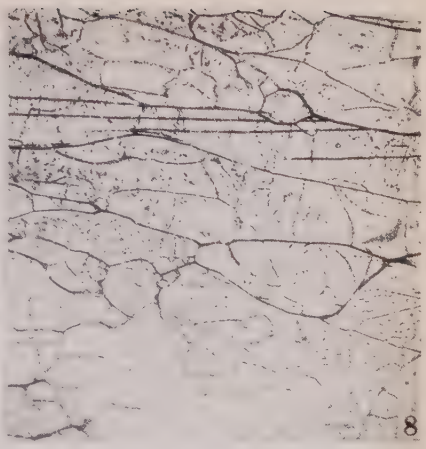
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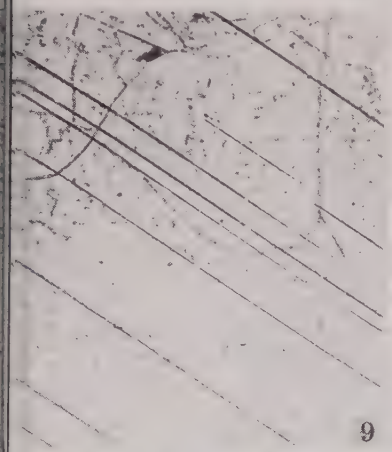
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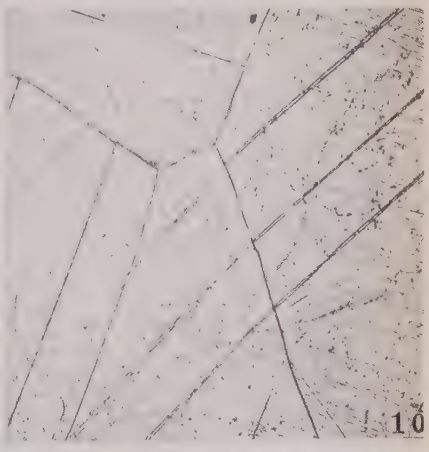
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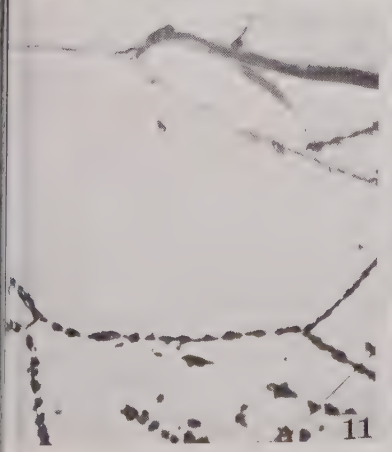
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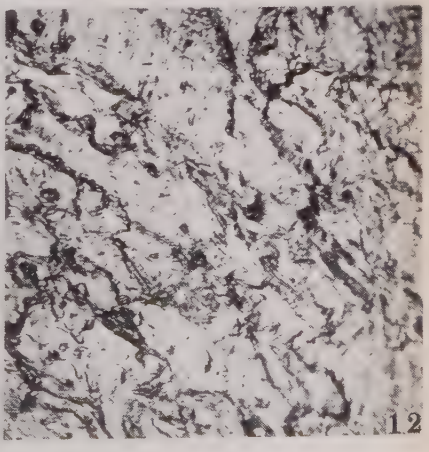
12

L. J. Spencer : Murnpeowie Meteoric Iron

Colour reactions in the micro-chemical determination of minerals.

(With Plate IV.)

By J. Adam Watson, F.I.C., A.C.G.I.

[Read November 1, 1934.]

THE rapid determination of the chemical elements present in a mineral has been a desideratum ever since minerals became of economic use. Various methods have been employed, starting with blowpipe work, which in the early days proved of great value, especially in experienced hands. With the development of chemistry and the discovery of new elements, this process was largely abandoned in favour of the standard 'wet method' of chemical analysis. Later on, micro-chemical reactions came into limited employment. Here the appearance of easily crystallizable salts under the microscope was used for diagnostic purposes. This method has been extensively examined of late years and became so overloaded with precautions that its chief asset, that of rapidity and ease of employment, has been largely lost. Quite recently colorimetric reactions have been applied to qualitative analysis. These appeared so promising that the present author was encouraged to endeavour to apply them to the examination of minerals.

A scheme for the qualitative determination of the commoner elements was published by G. Gutzeit[1] in 1929, which at first sight looked very attractive. Some of the reactions, however, were not reliable, and on that account did not appeal to the author, who was seeking a method that could be put into comparatively inexperienced hands. In 1931 a book was published by Dr. F. Feigl[2] in which is a comprehensive study of the whole subject of colour or 'spot' reactions. This book was taken as a basis on which to work. The most delicate reaction for each element was selected and tested in presence of all other elements which gave any reaction. This involved a considerable expenditure of time, but in the end a number

[1] G. Gutzeit, Helv. Chim. Acta, 1929, vol. 12, p. 829.

[2] F. Feigl, Qualitative Analyse mit Hilfe von Tüpfelreaktionen. Leipzig, 1931.

of reagents was found which gave specific reactions under simple and easily attained conditions. Some few elements did not give any characteristic reaction and have been omitted. Again, in one or two cases it was found that certain reactions were indeterminate in presence of one other element. These have been included, as more characteristic reactions are not available at the moment.

The method of carrying on the tests can be very briefly described. The solution to be tested is contained in a small test-tube, and one drop is placed by means of a small pipette either in a cavity of a spotting-plate or on a filter paper. A drop of the reagent is then added and the colour observed. When it is necessary to treat the test solution prior to the actual testing this treatment is carried out in a watch-glass, the solution being filtered if necessary. In the main the development of a colour on adding the reagent is sufficient to indicate whether an element is present. Some few of the reactions here described gave stains with more than one element, and it is necessary to treat the stain further to see whether either or both are present, or the original solution may be specially treated and re-tested.

It should be noted that when a test is being carried out on filter paper it is advisable to allow the two solutions to mix by spotting the second solution just beyond the edge of the first. By this means any change in colour in the reagent is more easily detected, as the original colour is always present as a comparison.

The apparatus required is of the simplest description. For holding the solution to be tested small test-tubes 3 inches by $\frac{1}{2}$ inch are most suitable. Small wooden stands for these should be provided or a small rack to hold six tubes. The reactions are carried out either on a spotting-plate provided with shallow cavities or on filter paper. The filter paper should be a good ashless paper and should not give any reaction with the reagents that are to be used on it. Where heat has to be employed small porcelain dishes are required. As it is difficult to obtain any of a reasonably small size the lid of a crucible from which the ring has been removed has proved very satisfactory. For carrying out precipitations prior to the actual testing watch-glasses are eminently suitable. A number of pipettes must be prepared by drawing out pieces of thin glass tubing to a fine point. As some of the reactions are best seen against a black background it is a good plan to cover the working part of the bench with a sheet of plate glass underneath which for one half of its area is a

of black paper and under the other half white paper. By this s the required background may be readily obtained. The re- ss should be kept in tightly closed bottles. If the work is to be d out in a permanent laboratory the most satisfactory is a one- ether bottle having a cap ground on to the outside of the neck. such a bottle without an inside stopper a small pipette can be permanently in the bottle and any danger of contamination ted.

is frequently necessary to filter a small quantity of liquid and are three methods whereby this can be achieved. In the first a filtering tube is prepared by drawing out a piece of fine glass g so as to form a fine capillary tube about one inch long. This lary is left attached to the long end of the original tube while e other end it is cut off just where it widens out. By this s a tube is obtained consisting of three parts: (1) a wide part iameter of the original tube, (2) a capillary part one inch long, g at its end (3) a slight expansion in diameter. A very small ent of filter paper is rolled up and inserted in the widened part capillary. By placing this filter paper in the drop of liquid filtered and applying suction at the end of the wide tube, clear d may be drawn up into the capillary. The filter paper can be removed and the clear liquid blown out either on to filter r or a spotting-plate.

the final reaction is to be carried out on a filter paper, a second od may be adopted. A pointed strip of filter paper is dipped the liquid to be filtered, when the clear liquid will pass up on to lter paper where it may be tested. Finally, the third method sts of taking the liquid and precipitate up in a small pipette pressing the point of this pipette firmly on to a filter paper, the liquid will pass on to the paper leaving the precipitate in centre of the spot.

ne or two special pieces of apparatus are required for certain , but these will be described in their appropriate place. A small ussion mortar and a small agate mortar are required in order to der the material under test. In this connexion it should be embered that the smallest sizes of these obtainable will be suffi- t for any of this work.

ethod of preparing the solution for testing.—When dealing with tances that are soluble in water or in *dilute* hydrochloric acid it uite sufficient to prepare a weak solution in either of these

liquids. In no case is it necessary to have a solution stronger tha 0·5 %. Strong hydrochloric acid may be employed if it gives a cle solution of the substance, but the excess of acid must be remove before the tests are applied, since in many cases a strong acid inte feres with the reactions. Most minerals, however, will not give wit either of these methods a solution that can be relied upon to contai all the elements originally present. The most satisfactory way t treat an unknown mineral is to fuse a small quantity of the finel powdered material with sodium carbonate in a loop of platinum wir Complete decomposition is obtained by adding to the fused bead small quantity of sodium peroxide. When metals which alloy wit platinum are suspected the mineral powder should be mixed wit the sodium carbonate before preparing the bead. The fused bead s obtained is treated with distilled water in a watch-glass and th liquid decanted or filtered from any insoluble material. The in soluble residue is then treated with strong hydrochloric acid. B this means a separation is obtained which greatly assists the ensuin testing. In the aqueous solution will be found all acidic element which form soluble sodium salts; the remaining elements will b found in the hydrochloric solution, except the two which form in soluble chlorides and can easily be distinguished.

By the use of sodium peroxide the elements are obtained in thei highest state of oxidation. Thus chromium will appear in the alkalin solution as sodium chromate. Although titanium forms a sodiun titanate, it appears in the acid solution, since the sodium titanat formed is insoluble in water. The great advantage of the metho is that it ensures that silica will not appear in the hydrochloric aci solution. This removes the uncertainty caused by the insolubilit of silica if solution is attempted by the use of either hydrochlori acid or aqua regia. Again, baryte is broken up in this process; th sulphate radicle is removed as sodium sulphate in the aqueous solu tion and the barium appears as barium chloride from the action o hydrochloric acid on the barium carbonate.

By the treatment outlined here the aqueous alkaline solution ma contain the major quantity of the following elements: Na, K, B, Al Si, Sn, P, V, As, Sb, S, Cr, Mo, W, Cl, F; while the acid solution ma contain similarly: Cu, Ag, Au, Mg, Ca, Ba, Sr, Cd, Hg, Ti, Pb, U Mn, Fe, Co, Ni. Certain elements may appear in both solutions among these are Sb, As, &c.

The complete reactions of all the elements so far examined will b

d in table I (plate IV). There are a number of omissions in this It is hoped later on to fill these gaps, but up to the present as not been possible to obtain results which are comparable eliability with those that are here given. The most notable ssions are lithium, beryllium, and platinum, all of which fail to w any really characteristic reactions. Quinalizarine is a reagent uently advocated for beryllium, but so far it has not been found sible to determine the conditions which will render this a reliable without considerable experience and probably special apparatus. was therefore considered advisable to omit it from the present ussion. With regard to the rare-earths, cerium, thorium, lan- ium, &c., a considerable amount of work remains to be done re they can be fitted into the scheme.

he following descriptions of the reactions should be read in con- tion with table II (p. 27). They give the detailed information ssary to make the determination of the various elements as simple conclusive as the method permits. The elements are arranged rding to the periodic classification.

odium —Zinc uranyl acetate is the only satisfactory reagent for ium. All interfering elements may be removed by precipitation Am_2S and Am_2CO_3 and filtering. Owing to the prevalence of element a positive reaction will be common.

otassium.—Sodium cobaltinitrite in the presence of acetic l gives a yellow precipitate. Similar precipitates are given by Ba, Zr, but these are all soluble on heating. Thallium gives recipitate which is indistinguishable from potassium, and in sence of this the test is inconclusive. The test should be carried in a watch-glass on a black background.

Copper.—The reaction with ammonium mercury thiocyanate and sulphate in presence of ammonium phosphate in a faintly acid ition is specific and sensitive as the phosphate prevents any in- erence by iron.

Silver.—The well-known reaction with potassium chromate is cific in presence of acetic acid.

Gold.—Stannous chloride reduces solutions of gold giving a purple n. Mercury and molybdenum give similar stains. In the case nolybdenum the stain will disappear on the addition of KCNS l subsequent boiling in water. The mercury stain does not yield ny treatment, so in presence of this metal the test for gold is terminate.

Magnesium.—Titan yellow in alkaline solution gives colour lakes with a number of the elements, but these can all be removed precipitation with ammonium sulphide. If zinc, cadmium, coba nickel, or iron only be present, the addition of potassium cyani will enable the reaction to be carried out without the necessity filtering. Aluminium although it gives no reaction itself inhibits t reaction with magnesium and must therefore be removed.

Calcium is a difficult element to deal with and the best results a obtained with the sodium salt of dihydroxy tartaric osazone. Oth reacting elements must be removed by precipitation with ammoniu sulphide and subsequent filtration. After adding the reagent at lea fifteen minutes must be allowed to elapse before concluding th calcium is absent. Magnesium except in very strong solutions giv no precipitate.

Strontium and Barium.—Both these are detected by sodium rhod zonate and both give brown stains. The only other reacting eleme is lead, and all three behave differently when their stain is treate with dilute hydrochloric acid. The strontium stain disappears once. The lead stain turns purplish and fades slowly, while t barium is unaffected in colour and fades very slowly. Thus bariu may be detected in presence of either of the other elements. To dete strontium, add a little potassium chromate to the solution, filter on a filter paper by means of a pipette according to the third meth described above, and test the edge of the drop with the reagent. Bo barium and lead chromate are retained as precipitates. The reage does not keep in solution and should be made up fresh as require

Zinc.—The reaction described under copper is specific if copp sulphate be substituted for zinc sulphate and the same procedu adopted.

Cadmium.—Diphenyl carbazide and potassium thiocyanate gi colour reactions with several elements, but the effect of ammonia these enables cadmium to be detected in their presence. A blan test should be made for comparison as the reagent is decided coloured. Care should be taken that the dilution of both tests is t same. Cobalt reacts similarly to cadmium and if there is a quantity present the test is inconclusive. The reagent does not ke well in solution.

Mercury as well as silver, gold, and copper gives a violet coloratio with dimethyl-amino-benzal rhodanine. By treating the soluti with HCl and then sodium phosphate it is easy to eliminate silv

Cu	$Am_2Hg(CNS)_4 + ZnSO_4$	Porc. dish	1 d. soln., 1 d. Am_2HPO_4, acidify conc. H_2SO_4, 1 d. $ZnSO_4$, 1 d. reagent, warm.	Violet rec
Ag	K_2CrO_4	Spot plate	1 d. soln., 1 d. reagent, 1 d. acetic acid.	Red
Au	$SnCl_2 + HCl$	F. paper	1 d. soln., 1 d. reagent, 1 d. KCNS, boil in water.	Purple
Mg	Titan yellow	Spot plate	1 d. soln., 1 d. Am_2S, warm, filter, 1 d. reagent, 1 d. NaOH.	Pink
Ca	Dihydroxy tartaric osazone	Watch-glass	1 d. soln., 1 d. Am_2S, warm, filter, few grains reagent.	White ppt
Sr	Sodium rhodizonate	F. paper	1 d. soln., 1 d. K_2CrO_4, 1 d. reagent on edge of spot.	Brown
Ba	,, ,,	,,	1 d. soln., 1 d. reagent, 1 d. dil. HCl.	Brown
Zn	$Am_2Hg(CNS)_4 + CuSO_4$	Porc. dish	1 d. soln., 1d. Am_2HPO_4, acidify H_2SO_4, 1 d. $CuSO_4$, 1 d. reagent, warm.	Violet
Cd	Diphenyl carbazide thiocyanate	Spot plate	1 d. reagent, 1 d. soln., 1 d. AmOH.	Violet
Hg	Dimethyl-amino-benzal rhodanine	F. paper	1 d. soln., 1 d. HCl, 5 d. Na_2HPO_4, filter on paper, 1 d. reagent on edge.	Pink
B	Turmuric	Porc. dish	1 d. reagent, 1 d. soln., 1 d. HCl, evap. to dryness, 1 d. NaOH.	Green
Al	Alizarine S	Spot plate	1 d. soln., 1 d. NaOH, boil, filter, 1 d. reagent, 2 d. acetic acid.	Pink
Tl	Potassium iodide	,,	1 d. soln., 1 d. reagent, 1 d. $Na_2S_2O_3$.	Yellow
Si	Am_2MoO_4 + benzidine	Porc. dish	2 d. reagent, 1 d. soln., warm, 2 d. oxalic acid when cold, 1 d. benzidine, 2 d. Na acetate.	Blue
Ti	Hydrogen peroxide	Spot plate	1 d. soln., 1 d. H_3PO_4, 1 d. reagent.	Yellow
Zr	Alizarine + HCl	,,	1 d. soln., 1 d. HCl, 1 d. reagent.	Violet
Sn	Phosphomolybdic acid	F. paper	1 d. soln., 1 d. HCl, few grains Mg powder, transfer to filter paper, 1 d. reagent.	Blue
Pb	Dithizon	Spot plate	1 d. soln., 3 d. KCN, 1 d. AmCl, 1 d. reagent. (Run blank.)	Pink
P	Am_2MoO_4 + benzidine	Porc. dish	2 d. reagent, 1 d. soln., 1 d. benzidine, 2 d. Na acetate.	Blue
V	Aniline	F. paper	1 d. reagent, 1 d. soln. containing HNO_3.	Green
As	Gutzeit reaction	Sp. appar.	... ...	Black
Sb	Phosphomolybdic acid	F. paper	1 d. reagent, 1 d. soln., warm.	Blue
Bi	Thiourea	Spot plate	1 d. soln., 1 d. reagent, 1 d. HNO_3.	Yellow
Cr	Diphenyl carbazide	,,	1 d. soln., 1 d. H_2O_2, 1 d. AmOH, warm on watch-glass, acidify H_2SO_4, transfer, 1 d. reagent.	Violet
Mo	KCNS + $SnCl_2$	F. paper	1 d. conc. HCl, 1 d. soln. in centre, 1 d. reagent, 1 d. $SnCl_2$. (Colour on edge.)	Red
W	KCNS + $SnCl_2$	,,	,, ,, ,, ,, ,, (Colour in centre.)	Blue
U	$K_4Fe(CN)_6$	,,	1 d. soln. in watch-glass, 4 d. $Na_2S_2O_3$, transfer to filter paper, 1 d. reagent on edge.	Brown
SO_4''	Mercuric nitrate	Porc. dish	1 d. soln., 1 d. reagent, evap. nearly to dryness, 2 d. water.	Yellow
Mn	$Am_2S_2O_8 + AgNO_3 + H_3PO_4$	,,	1 d. soln., 1 d. $AgNO_3$, 1 d. H_3PO_4, few grains solid $Am_2S_2O_8$, warm.	Purple
F	$SiO_2 + H_2SO_4$, &c.	Sp. appar.	... ...	Blue
Cl	$K_2Cr_2O_7 + H_2SO_4$	,,	... ...	Violet
I	Starch paste	Spot plate	1 d. soln., 1 d. reagent, 1 d. KNO_2.	Blue
Fe	Potassium thiocyanate	,,	1 d. soln., 1 d. reagent, 1 d. HCl.	Red
Co	β-nitroso-α-naphthol	,,	1 d. soln., 1 d. AmCl, 2 d. AmOH, boil, 2 d. water, filter, 2 d. H_3PO_4, 1 d. KI, 2 d. $Na_2S_2O_3$, filter, 1 d. reagent.	Brown
Ni	Dimethylglyoxime	F. paper	1 d. soln., 1 d. H_2O_2, heat spot on paper, 1 d. reagent on edge.	Pink

and copper. Gold, however, is not affected by the treatment an renders the reaction inconclusive. It is advisable to run a blan test owing to the colour of the reagent.

Boron.—The well-known reaction with turmuric is specific.

Aluminium.—The best reagent is alizarine S. In acetic aci solution this gives a pink coloration. Many other elements give similar coloration, but most of these are removed by boiling wit caustic soda and filtering. A number which give soluble salts wit NaOH, such as molybdenum, chromium, vanadium, may be eliminate by precipitating with barium chloride and boiling. The excess c barium is removed by precipitation with NaOH and filtering. It i advisable in this last precipitation to evaporate to dryness.

Thallium reacts with potassium iodide to give a yellow precipitat which being insoluble in sodium thiosulphate is readily distinguishe from other coloured iodides.

Silicon and Phosphorus.—Soluble silicates and phosphates reac with ammonium molybdate in nitric acid solution to form yello complex molybdates. These complex molybdates bring about th oxidation of benzidine in alkaline solution with the formation of blue quinoid compound and molybdenum blue. On this is based th method for detecting these two acids. Phosphates react wit ammonium molybdate in the cold, while a gentle heat is necessar to bring about the combination with silicates. To detect silicates i presence of phosphates the reaction should be carried out in a porce lain dish and warmed. The liquid is removed from the precipitate phosphomolybdate and treated with two drops of oxalic acid whe perfectly cold. To this is added a drop of benzidine and then severa drops of sodium acetate. A blue colour shows the presence of silicate as the oxalic acid prevents the reaction with phosphates. T detect phosphates in presence of silicates the original solution evaporated to dryness twice with nitric acid whereby the silica rendered insoluble. Water is added to the residue and the clea liquid tested as above when a blue coloration indicates the presenc of a phosphate.

Titanium is detected by the yellow colour given to its solutions b hydrogen peroxide. Interference may be caused by the presence iron, molybdenum, chromium, and vanadium when these occur in th acidic form. If the original solution be acidified with phosphor acid, iron will cause no trouble. The three other elements may b removed by precipitation with barium chloride.

rconium gives a specific reaction with alizarine in presence of ochloric acid.

n and Antimony both react with phosphomolybdic acid to give ue coloration. Both metals must be in the lower state of oxida- . This permits a distinction between the two, and if both are ent they should be precipitated as sulphides by ammonium hide in presence of a very little hydrochloric acid. The precipi- is then boiled with concentrated hydrochloric acid, which gives antimony as $SbCl_3$ and the tin as $SnCl_4$. Under these conditions mony reacts with phosphomolybdic acid, while tin does not. If her drop of the same solution be reduced by magnesium powder tested on filter paper with ammonium molybdate solution a blue ration will be obtained if tin be present. The antimony reaction phosphomolybdic acid takes place rather slowly and the colour take some time to develop.

ead.—Dithizon (diphenyl thiocarbazone) gives colour reactions a number of metals, but the addition of potassium cyanide and monium chloride will prevent any other element but lead from ting. The reaction is best carried out on a spotting-plate and a k should be run, since the potassium cyanide imparts a definite ur to the reagent. Dithizon does not keep well in solution and uld not be used unless it is of a clear deep green colour. In the rature carbon disulphide is recommended as a solvent for dithizon, carbon tetrachloride has been found to be in every way more table.

Vanadium in the presence of nitric acid gradually develops a p green colour with a solution of aniline in hydrochloric acid. romates behave similarly, but by boiling with strong hydrochloric d they are reduced to chromium chloride which shows no re- ion.

Arsenic.—The most reliable and sensitive reaction for arsenic is t developed by Gutzeit, and consists in noting the effect of AsH_3 mercuric chloride. The reaction is carried out in a small bottle ovided with a rubber stopper through which passes a narrow glass be, the bottom end of which is sealed and has a small hole blown one side. On the top of this tube is placed a piece of filter paper pregnated with mercuric chloride solution, while a roll of paper pregnated with lead acetate is inserted inside the tube. The solu- n to be tested is poured into the bottle which contains zinc free m arsenic and pure dilute hydrochloric acid. A little stannous

chloride should be added to reduce the arsenic solution if necessar By this means any arsenic is converted into AsH_3, which pass through the side hole of the tube, is freed from any H_2S by the lea acetate paper, and then attacks the mercuric chloride paper giving yellow to black stain, the depth of which is a measure of quantity arsenic present. The reaction is specific.

Bismuth reacts with thiourea in presence of nitric acid to give yellow coloration. Vanadium and chromium under similar cond tions give bluish colorations, but these are not sufficiently strong interfere with the bismuth reaction even when only small quantiti of the latter are present.

Chromium.—The test for chromium depends on the oxidizing actio of chromates on diphenyl carbazide in presence of sulphuric acid wi the development of a violet coloration. The oxidation to chroma is best carried out by means of alkaline hydrogen peroxide, and shou be continued until the addition of a little H_2SO_4 gives no bl colour. Mercury, molybdenum, and vanadium interfere with the tes but the mercury can be inhibited by HCl, and Mo and V by oxal acid.

Molybdenum and Tungsten both react with potassium thiocyana in presence of stannous chloride and hydrochloric acid. Molybdenu gives a red coloration which is soluble in hydrochloric acid to a re solution, while tungsten gives a blue insoluble colour. The color tion given on filter paper by the solution is treated with a drop concentrated hydrochloric acid when a red ring developing on th periphery indicates the presence of molybdenum and a blue spot the centre that of tungsten.

Uranium forms a brown precipitate with potassium ferrocyanid Coloured precipitates are also formed with iron, copper, and titaniun These may be eliminated by sodium thiosulphate which reduces th iron and copper and precipitates the titanium as TiO_2. Filtratio is carried out with a pipette on filter paper according to the thi method above, and the edge of the spot is tested with the reagent.

Sulphur, according to the method of obtaining a solution of th material described above, appears as sulphate, and may be tested fo by means of mercuric nitrate, which, on heating to dryness and trea ing with water, forms a yellow basic mercuric sulphate. The sam reaction is given with insoluble sulphates such as lead sulphate an barium sulphate, and thus forms a ready means of determining thes in the natural state.

Manganese is unique in giving a highly coloured permanganate
en treated with ammonium persulphate in presence of a trace of
er nitrate and concentrated phosphoric acid. The presence of
drochloric acid is not detrimental if sufficient silver nitrate be
ded to precipitate all the chloride. Gentle heat is necessary to
mplete the reaction which is specific.

Fluorine is easily recognized by the reaction between fluorides,
ca, and concentrated sulphuric acid when silicon fluoride is given
The test is carried out in a small glass tube. The material to
tested is mixed with powdered silica and two drops of concentrated
SO_4. On warming the gas is evolved. This is caught and de-
mposed in a drop of water on a glass rod held over the mouth of
tube. After one minute heating the liquid on the rod is tested
silica by means of Am_2MoO_4 and benzidine in the usual manner
en under silicon. A blue coloration indicates the presence of
orine. The test is specific.

Chlorine. The test for this element depends on the formation of
romyl chloride by the reaction of potassium bichromate and
phuric acid on a chloride, and the subsequent conversion by the
ion of water of this chromyl chloride into chromic acid and its
ection by means of diphenyl carbazide, with which it forms a
let colour. The solid substance to be tested is mixed with finely
wdered potassium bichromate and a few grains of the mixture
ced in a small ignition tube about $1\frac{1}{2}$ inches long, resting on the
of this tube is another slightly larger in diameter and having one
drawn out to a capillary. In this capillary is a drop of a solu-
n of diphenyl carbazide, and this projects a very short way into
ignition tube. A drop of concentrated sulphuric acid is added
the mixture in the ignition tube and the capillary is placed in
sition. The ignition tube is warmed, and if chlorine be present in
substance tested, the reagent in the capillary will become violet.
bromine or iodine are suspected, a little phenol added to the
xture will prevent their interference.

Iodine.—The standard test with starch paste using potassium
rite as a reducing agent is quite satisfactory.

Iron gives a red colour with potassium thiocyanate in presence of
drochloric acid. It is discharged by stannous chloride, and may
us be distinguished from the colour given by molybdenum.

Cobalt.—The most sensitive reagent for this metal is β-nitroso-α-
phthol. Similar brown stains are given with other elements, but

these may all be removed by precipitation with ammonia in presence of ammonium chloride and the addition, after filtration, of potassium iodide and sodium thiosulphate to the filtrate. If there be no copper present the treatment with potassium iodide and sodium thiosulphate can be omitted. Nickel gives a similar colour to cobalt, but it is destroyed by dilute hydrochloric acid.

Nickel.—Dimethylglyoxime gives a pink coloration with nickel and coloured precipitates with iron, manganese, and cobalt. These last may be eliminated by oxidizing the solution with hydrogen peroxide in presence of ammonium carbonate and filtering on to filter paper by the pipette method. The edge of the spot should then be tested with the reagent.

In carrying out a qualitative analysis by the tests given above no special scheme is necessary. The time required for each test is so short that the whole range may be gone through in about half an hour, at the end of which all the constituents, as far as they are contained in the tables given here, will be known. Comparatively little experience is necessary, and that little will be gained by going through the tests on pure material as a preliminary. The technique is largely one of obtaining a reliable and complete solution of the mineral being examined and becoming accustomed to dealing with very small quantities. In this last lies the main advantage and main difficulty of the method. Any one who is accustomed to ordinary analytical methods will find some difficulty at first in accommodating his ideas to the apparently microscopic quantities employed. But once this new attitude has been acquired the procedure will be very simple.

Knowledge of mineralogy will of course indicate what tests may safely be omitted, but if that knowledge is not available, then all the elements should be tested for and table II gone through in its entirety, after which the composition of the mineral should not be in any doubt.

In conclusion I wish to record my thanks to the authorities of Edinburgh University for their courtesy and kindness in allowing me the facility for carrying out this work. Also to the staff of the Geological Department of that University for much helpful criticism

Reagents required.

izarine: saturated solution in alcohol, add HCl till yellow, dilute with equal me alcohol, and filter.

izarine S: 0·1 % solution in water.

mmonium mercury thiocyanate: 9 gm. $(NH_4)CNS$, 8 gm. $HgCl_2$. 100 c.c. r.

mmonium molybdate: 5 gm. $(NH_4)_2MoO_4$, 100 c.c. water (dissolved cold), add 35 c.c. HNO_3 (density 1·2).

mmonium persulphate: solid.

iline: aniline hydrochloride dissolved in concentrated HCl.

nzidine: 0·05 gm. benzidine dissolved in 10 c.c. glacial acetic acid, dilute to c.c. with water.

hydroxy tartaric osazone: solid.

methyl-amino-benzal rhodanine: 0·03 % solution in acetone.

methylglyoxime: 1 % in alcohol.

iphenyl carbazide: 1 % in alcohol.

do. do. thiocyanate: saturated solution in cold alcohol. Satu- with KCNS and add crystal of KI.

henyl thiocarbazone (dithizon): 0·002 % in carbon tetrachloride.

ydrogen peroxide: 20 vols.

ercuric nitrate: 10 % $Hg(NO_3)_2$ in 1 % HNO_3.

Nitroso-α-naphthol: 2 gm. dissolved in 100 c.c. glacial acetic acid and diluted 100 c.c. water.

otassium bichromate: solid.

do. chromate: 1 % in *N* acetic acid.

do. ferrocyanide: 2*N* solution.

do. iodide: *N* solution.

do. thiocyanate: 2*N* solution.

osphomolybdic acid: 5 % solution.

dium cobaltinitrite: solid.

do. rhodizonate: 5 % solution.

iourea: 10 % solution.

tan yellow: 0·1 % solution.

rmuric: 20 gm. turmuric extracted with 50 c.c. alcohol, filtered, and diluted 50 c.c. water.

nc uranyl acetate: 10 gm. uranium acetate dissolved in 6 c.c. of 30 % acetic by heating. Dilute to 50 c.c. with water. 30 gm. zinc acetate dissolved in . of 30 % acetic acid. Dilute to 50 c.c. Mix two solutions, add trace of NaCl, v to stand 24 hours. Filter.

cetic acid: 2*N*.

ydrochloric acid: concentrated and *N*/10.

tric acid: *N*.

osphoric acid: concentrated.

xalic acid: *N*.

lphuric acid: concentrated.

dium hydroxide: 5*N* and *N*/10.

mmonia solution: concentrated.

mmonium carbonate: 5*N*.

do. chloride: saturated

do. phosphate: 5*N*.

Ammonium sulphide: concentrated.
Barium chloride: *N*.
Copper sulphate: *N*/100.
Mercuric chloride: saturated.
Potassium chromate: *N*.
do. cyanide: 5*N*.
do. nitrite: *N*.
Sodium acetate: saturated.
do. carbonate: anhydrous.
do. peroxide: solid.
do. phosphate: 2*N*.
do. thiosulphate: *N*.
Silver nitrate: *N*.
Stannous chloride: *N* in concentrated HCl.
Starch: solid.
Zinc granulated (free from arsenic): solid.
Magnesium powder: solid.
Zinc sulphate: *N*.

N = Normal solution containing the molecular weight of the salt in 1000 c. of water.

* Solutions of these reagents do not keep well and should be made up required.

All solutions are made in distilled water unless another solvent is indicate Alcohol used is 90 % industrial spirit.

e determination of small amounts of copper in rocks.

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[Read June 7, 1934.]

modern petrology increasing importance is being attached to the content of minor chemical constituents, the determination of ch is now frequently required, whereas hitherto they have usually n disregarded. In consequence, methods for their accurate de-nination in small amount have not always been fully worked out. pper is a case in point, and it is already clear that the method e advocated will show that this metal is much more widely dis-uted in rocks than is generally realized. Moreover, the use of a e sample, such as 20–50 grams, is no longer necessary.

n attempting to apply to rocks the very sensitive colorimetric thod described by T. Callan and J. A. Russell Henderson,[1] various iculties were encountered, and modifications were developed reby the method can be adapted to the determination of from 01–0·25 % of CuO in silicate rocks and minerals. The reagent d is sodium diethyl-dithio-carbamate, which gives a yellow colour h copper in slightly ammoniacal solution. The authors give a of other metals which also give a coloration or turbidity with s reagent. The following, taken from their list, are the metals ch are present in rocks and the reactions they give:

Copper	yellow
Aluminium	white
Ferrous iron	brown
Ferric iron	deep brown
Manganese	very faint turbidity
Nickel	yellow white turbidity
Titanium	yellowish-white turbidity
Zinc	white turbidity
Chromium	very faint turbidity

[1] T. Callan and J. A. R. Henderson, Analyst, London, 1929, vol. 54, p. 650.

In addition to the above list, N. Strafford [1] states that bismut also gives the same colour as copper. However, Hillebrand an Lundell [2] state 'It is quite safe to say that bismuth will not b encountered in the analysis of rocks and rarely in that of minerals In any case, it is precipitated by ammonia. The writer finds tha thallous salts cause a serious turbidity, and it is necessary for minera separated in Clerici solution to be washed very thoroughly with hc water before examination. Chromium, zinc, nickel, and manganes are incompletely precipitated by ammonia, but the amounts of th first three of these in rocks are insufficient to have a disturbin influence. In the case of the sixteen copper determinations given i the table (p. 39) it was found that, after precipitation by ammoni no turbidity resulted in any one case, although the MnO originall present varied from 0·08 to 0·38 %. Experiments conducted with standard titania solution showed that 0·002 gm. of TiO_2, in 10 c.c of the reagent and 90 c.c. of water made slightly ammoniacal, wa sufficient to give a yellow brown colour, together with an appreciabl turbidity. Fortunately titania is completely precipitated by ammoni The organic reagent, however, is extremely sensitive to iron. It therefore evident that the separation of the undesirable constituen by precipitation with ammonia has to be performed with the greate care.

The most convenient method of decomposing the rock to ensu the inclusion of any copper present as silicate is clearly attack by mixture of sulphuric and hydrofluoric acids.[3] It was found, howeve that in spite of the utmost care in the ammonia precipitation, th filtrate usually gave a strong iron reaction with the reagent. Indee an ammoniacal filtrate, free from the turbidity and coloration due t colloidal ferric hydroxide, may sometimes contain sufficient iron t render a colorimetric comparison for copper grossly inaccurate, if no impossible.

It appeared that either SO_4 ions, or fluorine in complex ions of th type $[FeF_6]$, were causing incomplete precipitation of the iron. Th

[1] N. Strafford, The detection and determination of small amounts of inorgan substances by colorimetric methods. London (Institute of Chemistry), 1933.

[2] W. F. Hillebrand and G. E. F. Lundell, Applied inorganic analysis. Ne York and London, 1929, p. 186.

[3] If preferred, the decomposition may be effected by fusion, followed by separation of silica, and then by the ammonia precipitations. It requires slight more time in manipulations than the procedure here described. Moreover, t large amount of sodium chloride present causes some turbidity with the orgar reagent.

partially confirmed by the discovery that, after very thorough poration to dryness, followed by an hour or more of baking, the ipitation of the iron was complete. The following series of exments showed that both the SO_4 ion and the complex fluorine were causing the trouble. 4 grams of iron alum were dissolved 0 c.c. of concentrated hydrochloric acid and made up to a litre. c.c. of the solution were taken for each of the experiments 1–3, ted to 200 c.c., and the ammonia precipitation carried out with following modifications and results :

1 c.c. of sulphuric acid was added. The filtrate gave a proced brown colour on the addition of only four or five drops of 1 % solution of the reagent. The precipitate was dissolved in rochloric acid and re-precipitated. The reaction of the second te with the reagent was nearly as marked as the first. A further pitation, however, effected a complete separation. After standfor several days the first two filtrates precipitated their iron as hydroxide.

0·5 gram of sodium fluoride was added. The filtrate gave a ion with the reagent which was practically the same as in riment 1. On re-precipitation the colour reaction of the filtrate undiminished.

The experiment was repeated with iron-alum alone. The iron tion of the filtrate was just the same as in experiment 1. The in the filtrate obtained on re-precipitation, however, appeared ave been reduced to about one-third of that from the first pretation.

An ammonia precipitation was carried out on a solution of c chloride (1 gm. in 200 c.c. of water and 5 c.c. of concentrated rochloric acid). The filtrate gave no coloration with the reagent. is concluded from these experiments that free sulphuric acid, e concentrations of sulphates, and the presence of fluorine, all rise to incomplete precipitation of iron. Fluorine can be comely removed by two evaporations of the acid mixture to strong ing, followed by evaporation to dryness. Baking for several hours bout 300° C. removes free sulphuric acid and, on subsequent solution ydrochloric acid, the sulphate ion concentration is apparently fficient to interfere with the precipitation of iron if two or more cipitations are made. In practice, only the first filtrate was found asionally to contain traces of iron, but this can be removed by the tious addition of dilute barium chloride followed by some more

ammonia, further boiling, and filtration through a double 40 Wha man paper. Excess of barium chloride should be avoided as it giv a slight turbidity with the reagent. It is necessary only to reduce t sulphate ion concentration. If the baking is thoroughly carried o this treatment will not be necessary. It would appear that sulphate when in sufficient concentration, cause a little iron to run throu the filter paper in the colloidal state, but the presence of fluorine much more serious since it allows iron to pass through in solution.

Callan and Russell Henderson state that if iron and alumina a present they may be removed by adding excess of ammonia a determining copper in the filtrate. Nevertheless, it is general recognized that copper is incompletely separated in this way.[1] ascertain both the extent to which copper is retained in the ammon precipitate and the applicability of this colorimetric method to ro analysis, the following experiments were conducted on sixte analysed specimens from the Malvern Hills. This was a varied co lection of plutonic, hypabyssal, and metamorphic rocks ranging fro 45 to 70 % of silica, as well as ferromagnesian minerals separat from them, in all of which not less than twenty-two constituents h been determined.

The method used and recommended for the determination of sma quantities of copper in silicate analysis is as follows. Two grams rock powder are heated in a platinum dish on a sandbath with 15 c of 1 : 1 sulphuric acid and 30 c.c. of hydrofluoric acid until the mi ture fumes strongly. After cooling, water is added and the mixtu is again evaporated to strong fuming. The temperature is th raised to fume off the sulphuric acid. This is carried on to dryne and the residue baked for several hours at about 300° C. The resid should be broken down and stirred from time to time to assist in t expulsion of sulphuric acid. The dried cake is treated with abo 15 c.c. of fairly concentrated hydrochloric acid on the water-ba and, after ten minutes, is diluted to about 50 c.c. and further heat until almost complete solution results. The liquid is filtered, a after the addition of a further 10 to 20 c.c. of concentrated hydr chloric acid, the ammonia precipitation is carried out under t standard conditions (see Hillebrand and Lundell), but with t addition of several c.c. of 1 : 1 ammonia in excess. The liquid then boiled for three to five minutes, filtered through a double

[1] W. F. Hillebrand and G. E. F. Lundell, loc. cit., p. 70. L. A. Haddock a N. Evers, Analyst, London, 1932, vol. 57, p. 495.

atman filter paper, and washed three times with boiling 2½ % monium chloride solution containing a few drops of ammonia (the of an indicator in the wash liquid is inadmissible). The precipi- is removed from the paper, dissolved in 5 c.c. of concentrated rochloric acid, re-precipitated, and filtered as before with a double r paper. Each filtrate is made up to 250 or 500 c.c.,[1] an aliquot t taken, and the colorimetric comparison carried out exactly as cribed by Callan and Russell Henderson, using a standard copper ution[2] containing 0·00001 gm. Cu per c.c. If more than 0·0001 Cu is present in 100 c.c. turbidity is developed with the reagent further dilution is required. The presence of the merest trace

Table showing retention of copper by the ammonia precipitate.

Amount taken	CuO in filtrates from 1st pptn. %	2nd pptn. %	3rd pptn. %	% retention in 1st ppt.	Total iron as Fe_2O_3	Al_2O_3 %	Total R_2O_3 ppt. %
2·0258	0·011	0·0016	—	14·5	8·27	17·75	27·81
2·1704	0·014	0·0043	—	30·7	12·87	15·28	30·02
1·3293	0·046	0·0041	—	8·9	9·67	15·36	26·20
1·0454	0·034	0·0068	—	20·0	13·39	15·02	30·93
2·0656	0·016	0·0074	—	46·2	14·81	15·07	32·48
2·0734	0·023	0·012	0·006	52·2	9·80	15·69	26·69
2·0448	0·031	0·0043	—	14·0	13·16	14·75	30·16
2·4782	0·073	0·0098	0·007	13·4	8·43	10·42	19·54
1·7975	0·012	0·0076	0·0056	63·3	11·19	8·60	22·14
2·4103	0·005	0·0033	0·0017	71·7	11·44	20·40	33·88
2·2370	0·008	0·0014	—	17·5	2·79	14·52	17·72
2·0992	0·022	0·0052	—	23·6	11·36	16·68	29·71
1·1959	0·018	0·0099	—	55·5	12·28	16·16	29·74
0·9824	0·030	0·019	0·009	60·3	18·51	10·32	31·86
0·4991	0·065	0·023	0·007	35·4	14·97	15·77	31·42
0·6747	0·063	0·010	—	15·9	6·57	15·70	22·43

ature of Specimens.—1 and 2. Greenstone. 3. Basic xenolith. 4. Hybrid. reenstone. 6. Basic xenolith. 7. Greenstone. 8. Biotite-pyroxenite. Hornblendite (almost pure hornblende). 10. Epidosite. 11. Granite. Hybrid sill. 13. Hybrid. 14. Hornblende separated from no. 13. 15. Bio- separated from no. 8. 16. Phlogopite separated from no. 8.

ote.—In the case of specimens 9 and 10, the determinations were made by the A. F. Smethurst, B.Sc., A.R.C.S., F.G.S. The others were carried out by writer.

[1] In the majority of cases 250 c.c. is the most suitable volume.

[2] It has been found that this solution hydrolyses on keeping. It is best to are it freshly by dilution from a solution containing 0·0001 gm. Cu. This is ared from A. R. copper sulphate and should contain a few drops of sulphuric

of iron in the test solution gives a brown tint with the organic r agent which is readily detected on comparison with the other tub containing copper as the only metal. The addition of some gelati solution, as recommended by Strafford (loc. cit.), increases the brill ance of colour somewhat, thereby facilitating comparison.

The figures given in the table show that an appreciable amount copper is retained by the ammonia precipitate. The average rete tion in these sixteen cases is 33·9 %, though in several it is as low a 10–15 %. Nevertheless, a second precipitation is always necessary and the copper content of the filtrate from this will show whether third precipitation is required. If the copper content is above 0·05 a third precipitation is necessary, and in some cases with less tha this amount. The use of a considerable excess of ammonia appea to have no effect on the degree of retention, and the alumina thereb re-dissolved is found to be insufficient to have any effect on th colorimetric comparison. Moreover, it has the advantage of precip tating the iron more completely, and in a form less liable to ru through the filters.

When the percentage retention is plotted against the R_2O_3 conten the retention curve, though irregular, rises with extreme rapidit after the R_2O_3 exceeds about 25 %. It is evident, therefore, tha with very basic rocks several re-precipitations will be necessary There appears to be no direct relation between the retention an proportions of iron and alumina, but only to the total R_2O_3 conten

Correction for CuO in R_2O_3 precipitate.—Unless the retention copper is shown to be high even after the re-precipitation of th ammonia precipitate, a correction for copper in the R_2O_3 precipitat of the main portion (which has also been precipitated twice) wi usually not be necessary. If the degree of retention shows such correction to be desirable for very accurate work, an approximatio to this correction is obtained by determination of copper in th filtrate from the third precipitation.

Indication of presence of appreciable copper.—When it is dry, th residue from the first evaporation of a rock powder with a mixtur of hydrofluoric and nitric acids (as in the determination of P_2O sometimes shows a greenish tinge, which appears to be decidedl more marked when the copper content is appreciable. This colour never visible after the second and third evaporations, for it is the masked by the deep brown of ferric salts.

Condition in which the copper occurs.—Though specimens of sulphid

of copper have been found there, the Malvern Hills can scarcely aid to have been mineralized. Sulphur has been determined in the specimens mentioned in this paper. It does not always vary ctly as the copper content, but in the majority of cases there is cient sulphur to make chalcosine. In two or three cases no hur or only a trace was recorded. As much as 0·04 % of metallic per only requires 0·01 % of sulphur to form chalcosine or 0·02 % chalcopyrite. In view of these circumstances and the fact that method for the determination of copper is much more accurate n those for sulphur, it is inadvisable to conclude that the presence opper in the absence of sulphur indicates the location of the metal silicate mineral unless the excess of copper over requisite sulphur onsiderable—say 0·1 %.

afeguards against contamination by copper.—The use of brass sieves he crushing of the sample should be avoided. Contamination ough prolonged heating on a copper water-bath is reduced to a imum, since only twenty minutes of such heating is required. ertheless, it is best to have the bath boiling only gently so that rting from the sides with possible introduction of copper cannot place. The reagents used, including the distilled water, should sted for copper.

cknowledgements.—I wish to acknowledge my indebtedness to istant Prof. H. F. Harwood, who first brought the use of this gent to my notice, and suggested that it might be applied to rock lysis. Assistant Prof. A. Brammall very kindly gave his consent he incorporation of data obtained in the course of analysis of his cimens. My thanks are also due to Professors P. G. H. Boswell J. C. Philip for the facilities afforded me in the Geochemistry oratory of the Imperial College of Science and Technology.

Almandine from Botallack, Cornwall.

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[Read November 1, 1934.]

WELL-CRYSTALLIZED icositetrahedral garnets from Botallack, Cornwall, are preserved in most British mineral collections, but they have previously not been systematically examined. The original specimens were discovered in 1821 by a St. Just miner who dealt in minerals, and the occurrence is first referred to by Carne in his paper 'On the mineral productions and the geology of the parish of St. Just' as follows: 'About six months ago, a mass of beautiful garnets, of a deep red colour, was found imbedded in the rock, not far from low water mark at the foot of Chycornish Carn, about a quarter of a mile south of Botallack. Some of the crystals were larger than hazel-nuts, and most of them were twenty-four sided. Some specimens of a very superior order were procured, each having from one to two hundred crystals on its face.'

The rocks of the locality are hornfelses in the aureole of the Land's End granite and consist of metamorphosed greenstones in which the garnets occur in veins. Mr. A. Russell, who has succeeded in discovering the original spot[2] where these garnets were obtained, states that all the garnet specimens have been removed, save for traces. There are, however, numerous specimens of the garnets with their associated matrix in the Carne collection preserved at Cambridge.

The home of these garnets is a biotite-rich layer of the altered greenstones which have suffered strong metasomatic metamorphism with removal of CaO and addition of K_2O and FeO, the biotite layer passing out into a zone rich in grunerite and in places also in cordierite. The associated rock is a metasomatic variant of the cordierite

[1] J. Carne, Trans. Roy. Geol. Soc. Cornwall, 1822, vol. 2, p. 309.

[2] Near low water mark on the cliffs close to Zawn a Bal, between the Crown and Wheal Edward.

hophyllite-rocks described by Tilley and Flett[1] from Kenid-
k.

The petrography of this rock and the significance of the garnet
ragenesis will be dealt with in a later communication by Prof. Tilley.
The garnet crystals are icositetrahedra (211) varying in size up to
iameter of 1·5–2 cm., the faces being striated parallel to the inter-
tions of possible dodecahedra. In some examples very small faces
110) truncate the corners of (211). The crystals are of a dark red
our, and the larger ones are crowded with inclusions most of which
of biotite or more rarely grunerite.

Material for chemical analysis[2] was obtained by picking out in-
idual crystals which were crushed, most of the inclusions removed
flotation in methylene iodide, and a pure sample finally obtained
hand-picking under a binocular microscope. An analysis was
e by the writer and the following results obtained.

SiO_2	35·58 %
TiO_2	trace
Al_2O_3	21·94
Fe_2O_3	none
FeO	38·54
MnO	0·70
MgO	0·68
CaO	1·68
H_2O (below 105° C.)	0·12
	99·24

alculating this analysis in terms of mineral molecules:

Almandine	89·00 %
Spessartine	1·65
Pyrope	2·29
Grossular	4·51
Corundum	1·79
Quartz...	0·06
Water...	0·12
	99·42

sidering the garnet molecules alone and raising to a summation
00 we have

Almandine	91·33
Spessartine	1·69
Pyrope	2·35
Grossular	4·63

C. E. Tilley and J. S. Flett, Summary of Progress, Geol. Surv. of Great
ain, 1930, for 1929, pp. 24–40. [Min. Abstr., vol. 4, p. 402.]

The specimen analysed was from the S. G. Perceval collection in the Depart-
t of Mineralogy and Petrology, Cambridge.

This gives us the following formula for the garnet molecule:

$$(Fe''_{91\cdot3}Mn_{1\cdot7}Mg_{2\cdot4}Ca_{4\cdot6})_3Al_2[SiO_4]_3$$

The theoretical composition of pure almandine corresponding t the formula $Fe_3Al_2[SiO_4]_3$ is:

SiO_2	36·15 %
Al_2O_3	20·51
FeO	43·34

The above analysis and calculated formula show the unusuall high proportion of almandine in the Botallack garnet. The follow ing analyses are of almandine from other localities and of comparabl purity. The percentage of the different garnet molecules has als been calculated from each analysis.

	I.	II.	III.	IV.	V.
SiO_2	38·36	37·39	37·25	38·63	39·66
Al_2O_3	18·03	20·72	19·43	21·81	19·66
Fe_2O_3	2·02	0·83	3·29	1·47	—
FeO	36·53	36·37	35·45	29·38	39·68
MnO	0·50	0·86	1·24	1·90	1·80
MgO	2·29	3·85	1·13	4·81	—
CaO	1·20	0·41	2·51	1·57	—
etc.	1·53	0·16	—	—	—
	100·46	100·59	100·30	99·57	100·80
Almandine ...	86·6	83·9	85·1	72·8	95·7
Spessartine ...	1·2	2·0	3·0	4·8	4·3
Pyrope	8·3	12·9	2·1	17·3	—
Grossular ...	—	—	—	0·2	—
Andradite ...	3·9	1·2	9·8	4·9	—

I. Thackaringa, New South Wales. Anal. W. A. Greig in G. W. Card, Rec Geol. Surv. N.S.W., 1920, p. 181 [M.A. 1–335]. Sp. Gr. 4·150.

II. Falun, Sweden. Anal. M. Bendig in G. Menzer, Zeits. Krist., 1929, vol. 69 p. 360 [M.A. 4–111]. Sp. gr. 4·188 ± 0·002.

III. Ceylon. Anal. M. Seebach, Inaug. Diss. Heidelberg, 1906; Centralbl. Min 1906, 774. Sp. gr. 4·040, n 1·7779.

IV. Odenwald. Anal. E. Rost-Hoffmann in G. Klemm, Notizbl. Ver. Erdk Darmstadt, 1919, Folge V, Heft 4, p. 20. Sp. gr. 3·9502, nNa 1·7964. Like th Botallack garnet, this occurs within a thermal aureole.

V. Falun, Sweden. Anal. W. Hisinger, Journ. Chem. Phys. (Schweigger), 1817 vol. 21, p. 258.

It will be seen that the Botallack garnet shows a higher propor tion of almandine than any of the others quoted with the exceptio of no. V (Falun) with which comparison is unsatisfactory in tha

and Fe_2O_3 are not separated and neither MgO nor CaO determined.[1]

The Botallack analysis shows that there is an excess of alumina over that required by the fundamental formula. This is reflected by the presence of corundum in the calculated mineral composition. The ratio $RO : R_2O_3 : SiO_2$ is 2·76 : 1 : 2·76. This divergence from the accepted 3 : 1 : 3 ratio may perhaps be best explained by the hypothesis that aluminium replaces both iron and silicon in the crystal structure. A similar suggestion has been made by Gossner[2] who found in three analyses of almandine from Irschenrieth, Ober-Pfalz, that the ratios were :

2·61 : 1 : 2·66
2·61 : 1 : 2·71
and 2·51 : 1 : 2·69

These show an excess of silica as well as of alumina. The excess of silica in the Botallack analysis is negligible. In the analyses of garnet previously quoted the ratios are :

I	... ...	3·13 : 1 : 3·37
II	... ...	2·98 : 1 : 3·00
III	... ...	2·76 : 1 : 2·94
IV	... ...	2·61 : 1 : 2·89
V	... ...	2·98 : 1 : 3·42

These analyses nos. I to IV are the only ones with which we can justifiably make any comparison, as in no. V FeO and Fe_2O_3 are not separated and it is in other ways incomplete. The complete analysis also shows the presence of small amounts of alkalis, phosphorus, and titanium. The alkalis and phosphorus are presumably present as impurities or inclusions, which makes consideration of the analysis difficult for our present purpose.

The analysis of the Botallack garnet, the three given by Gossner, nos. II, III, and IV above are thus deemed suitable for considera-

[1] Other analyses, having a somewhat lower percentage of almandine, but which are for various reasons unsatisfactory for purposes of comparison, are recorded as follows :
Wicklow, Ireland. J. W. Mallet, Journ. Geol. Soc. Dublin, 1850, vol. 4, p. 275.
Redding, Connecticut. Anal. F. L. Sperry in W. E. Ford, Amer. Journ. Sci., 1915, ser. 4, vol. 40, p. 34.
Arena, Sweden. Anal. J. F. Bahr, Öfvers. Vetenskaps-Akad. Stockholm, 1845, no. 1 (for 1844), p. 93.

[2] B. Gossner, Beitrag zur Stöchiometrie der Silicate. Zeits. Angewandte Chem., 1929, vol. 42, pp. 175–178. [M.A. 4–198.] Also B. Gossner and E. Ilg, Zentralbl. Min., Abt. A, 1932, pp. 1–12. [M.A. 5–528.]

tion, and in all of them, with the possible exception of no. II, alumin is found to be in excess of that required by the fundamental formul $3RO.R_2O_3.3SiO_2$. This can be more clearly shown if the analyse are recalculated in terms of the number of atoms of each kind in th molecule. In column (3) of the following table some Al is allotte where necessary to the Si group, and when this is done the smal amount of Fe‴ usually present is transferred to the (Mg,Fe″ . . group, or if no Fe‴ is available a corresponding amount of Al i similarly treated. It will be seen that in such a way a clos approximation to the ideal composition is obtained.

Locality.		(1). Per cent. by weight.	(2). Number of metal atoms on basis of 12 O.	(3). Arrangement in groups.		(4). Ideal composition
Botallack	SiO_2	35·58	2·94	0·06	3·00	3
	Al_2O_3	21·94	2·13	2·01	2·01	
				0·06		
	Fe_2O_3	—	—			
	MgO	0·68	0·08			
	FeO	38·54	2·65		2·99	3
	MnO	0·70	0·05			
	CaO	1·68	0·15			
Irschenrieth, Ober-Pfalz*	SiO_2	36·10	2·92			
	Al_2O_3	22·22	2·12	0·08	3·00	3
				2·04	2·04	2
	Fe_2O_3	1·24	0·08			
	MgO	1·21	0·15			
	FeO	29·75	2·01		2·95	3
	MnO	6·86	0·47			
	CaO	2·81	0·24			
Irschenrieth, Ober-Pfalz	SiO_2	36·24	2·94			
	Al_2O_3	22·25	2·14	0·06	3·00	3
				2·08	2·08	2
	Fe_2O_3	0·79	0·05			
	MgO	1·31	0·16			
	FeO	28·80	1·95		2·89	3
	MnO	8·81	0·60			
	CaO	1·49	0·13			
Irschenrieth, Ober-Pfalz	SiO_2	36·79	2·95			
	Al_2O_3	22·11	2·09	0·05	3·00	3
				2·04	2·04	2
	Fe_2O_3	1·85	0·12			
	MgO	1·54	0·18			
	FeO	27·61	1·85		2·90	3
	MnO	9·05	0·61			
	CaO	1·74	0·14			

* The three almandines from Irschenrieth were analysed by M. Arm and F. Spielberger.

ocality.		(1). Per cent. by weight.	(2). Number of metal atoms on basis of 12 O.	(3). Arrangement in groups.	(4). Ideal composition.
un	SiO_2	37·39	3·00	3·00	3
	Al_2O_3	20·72	1·95		
	TiO_2	0·16	0·01	2·01	2
	Fe_2O_3	0·83	0·05		
	MgO	3·85	0·46		
	FeO	36·37	2·43		
	MnO	0·86	0·06	2·98	3
	CaO	0·41	0·03		
on	SiO_2	37·45	3·03	3·04	3
	Al_2O_3	19·43	1·85		
	Fe_2O_3	3·29	0·20	2·05	2
	MgO	1·13	0·14		
	FeO	35·45	2·40		
	MnO	1·24	0·08	2·84	3
	CaO	2·51	0·22		
nwald	SiO_2	38·63	3·04	3·04	3
	Al_2O_3	21·81	2·02	2·11*	2
	Fe_2O_3	1·47	0·09		
	MgO	4·81	0·57		
	FeO	29·38	1·93		
	MnO	1·90	0·13	2·76*	3
	CaO	1·57	0·13		

These discrepancies are larger than in the other cases, and may be due to ible impurities in the material analysed, a fact which Klemm recognizes.

Several interesting features are shown by the analyses when stated his form. It is evident, for instance, that the Falun almandine ell represented by the formula $(Fe,Mg,Mn,Ca)_3(Al,Fe,Ti)_2Si_3O_{12}$. would also appear probable that in many cases a small amount of on is replaced by aluminium [1] and that this is accompanied by entry of small amounts of ferric iron into the (Fe,Mg . . .) up. The composition of such garnets may therefore be ex-ssed as

$$(Fe'',Fe''',Mg,Mn,Ca)_3(Al,Fe''',Ti)_2(Si,Al)_3O_{12}.$$

The refractive index of the Botallack garnet was determined as $= 1{\cdot}808 \pm 0{\cdot}002$. The method used was that of immersion of the ins in solutions of $AsBr_3$ and AsS in methylene iodide as suggested Borgström,[2] and the subsequent determination of the refractive ex of the liquid in a hollow prism on a goniometer.

F. Machatschki, Zeits. Krist., 1930, vol. 73, pp. 133, 134. [M.A. 4–277.]
L. H. Borgström, Compt. Rend. Soc. Géol. Finlande, 1929, no. 2, p. 3. [M.A. 49.]

The specific gravity as determined by flotation in saturated solu tions of thallium formate is 4·22. According to Ford's [1] diagram a garnet of the Botallack composition should have a refractive inde of about 1·82 and a specific gravity of about 4·2. The figures fo pure almandine are given as n 1·830 and sp. gr. 4·250.

Eskola [2] gives a diagram for the determination of the approximat composition of garnets from a knowledge of the refractive inde alone. From this the composition of the Botallack garnet shoul be about $Fe_{82}Mg_{12}Ca_6$, i.e. almandine 82 % by weight, pyrope 12 % and grossular 6 %. In this case, there is a rather poor correspondenc between the chemical composition and the physical properties a suggested by Ford and Eskola. It is clear that these simple physica data do not at present always afford a reliable means of accurately diagnosing the chemical composition of garnets, and further work i correlating the physical properties with accurate analyses is re quired.

The writer wishes to express his thanks to Prof. C. E. Tilley a whose suggestion and under whose supervision this work was under taken.

[1] W. E. Ford, Amer. Journ. Sci., 1915, ser. 4, vol. 40, p. 42. [M.A. 2–37.]

[2] P. Eskola, On the eclogites of Norway. Vidensk. Skrift. Kristiania, 192 no. 8, p. 9. [M.A. 2–313.]

MINERALOGICAL ABSTRACTS

(Vol. 6, No. 1, March, 1935.)

Notices of Books.

EWINSON-LESSING (F. Y.)] Левинсон-Лессинг (Ф. Ю.). Петрографія. Изданіе третье. [*Petrography*. 3rd edition.] Гос. Научно-Техн. Горно-Геолого-Нефт. Изд., Ленинград [State Sci.-Techn. Mining-Geol.-Oil Publications, Leningrad], 1933, 460 pp., 275 figs., 1 diagram. Price 6 roubles (unbound), 7*r*. 25*k* (bound).

a third enlarged and corrected edition of the well-known book A. 3–64]. Petrology (general part, pp. 4–163) and petrography cial part, pp. 164–433) are included. Many Russian examples given. The chemical classification of igneous rocks according to scheme of the author is emphasized. The discussion of magmatic vinces and theories of differentiation are of exceptional interest. sedimentary rocks (pp. 337–391) and the metamorphic rocks 392–433) also receive an adequate treatment. A short appendix 434–441) contains a chapter on the technical aspect of petrology an explanation of the chemical classification diagram by V. N. ochnikov.

S. I. T.

SCH, Cecil (H.). *The chemistry of solids*. Ithaca, New York (Cornell University Press) and London (Oxford University Press), 1934, xi + 213 pp., portrait and 55 figs. on plates and in text. Price \$2.50 = 11*s*. 6*d*.

his is the thirteenth volume of the series 'The George Fisher er non-resident lectureships in Cornell University', and it con- as the substance of the lectures given there by the author in the ter of 1931–32. A wide range of subjects is covered, but the n part deals with crystals (which are, of course, solid chemicals) n the point of view of structure and physics, rather than of mistry. Alloys are often given as examples. There are useful pters on The growth of crystals, Adsorption and crystal habit, crystal boundary, Etch-figures, Mosaic structure in crystals. Widmanstätten structure, The martensitic structure, The layered ice, Fibre structure, &c. In each chapter an interesting historical ount is given of the beginnings of the subject and a review of the st recent work, with many references to the literature up to 1932.

L. J. S.

RANDALL (J. T.). *The diffraction of X-rays and electrons by amorphou solids, liquids, and gases.* London (Chapman & Hall), 193 xii + 290 pp., 28 pls., 150 text-figs. Price 21*s.*

A useful survey of work in many different fields by X-ray an electron diffraction methods. An adequate theoretical treatmen and an account of the technique employed necessarily give the boo a physical bias, but the results obtained concern also the biologi and geologist. To the latter the chapter on glass and coal bring important information and foreshadows possible applications of th X-ray method to the study of the orientation of 'primary inclusions and the identification of the devitrification products of natura glasses. The mineralogist, however, will be disappointed that n space has been found for the resins, nor chalcedony and opal. Th book is liberally illustrated with excellent reproductions of very fin X-ray and diffraction photographs and the bibliographies given a the end of each chapter form an invaluable guide to the widel scattered literature on each subject. F. A. B.

HARTSHORNE (N. H.) & STUART (A.). *Crystals and the polarising microscope. A handbook for chemists and others.* With a for word by G. T. MORGAN. London (Edward Arnold & Co.), 193 viii + 272 pp., 217 figs. Price 16*s.*

This book gives a good outline of the geometrical and optic characters of crystals, followed by a description of the microscop and its use in the determination of optical characters. It thus cove the same ground as that given in elementary text-books on crystall graphy, mineralogy, and rock-forming minerals. The importance this subject to chemists is emphasized, and an interesting chapt gives examples of how the polarizing microscope has been of speci use in certain chemical problems. There is no mention of P. Groth 'Chemische Krystallographie,' nor of W. H. Fry's 'Tables for th microscopic identification of inorganic salts' [M.A. **2**–243], and on a casual reference to A. N. Winchell's 'Microscopic characters artificial inorganic solid substances' [M.A. **5**–2]. The illustratio are good and the book is well printed. L. J. S.

BLACKTIN (S. Cyril). *Dust.* London (Chapman & Hall), 193 xi + 296 pp., 2 pls., 2 text-figs. Price 18*s.*

Dust is everywhere on the earth's surface and in the atmospher As coexistent with the atmosphere the term staubosphere is intr duced. In many cases the material consists of mineral particle

organic matter is also often present. The author has brought ther a large amount of useful information, but the compilation style are at times a little obscure. The dust arising in industrial cesses often presents a special problem. Cosmic dust is con- red, but there is no mention of cryoconite. The 545 references he literature (including recent newspaper reports) are collected ther at the end of the volume, and there is a good index to a erse range of subject matter. L. J. S.

NCKWORTT (P. W.). *Lumineszenz-Analyse im filtrierten ultra-violetten Licht.* Mit einem Beitrag von J. EISENBRAND über *Quantitative Messungen.* 3rd edition, Leipzig (Akad. Verlags-gesell.), 1934, viii + 190 pp., 62 figs. on 16 pls. and in text. Price 8·50 Mk.

his third edition shows an increase of 84 pages on the first edition 928 [M.A. **4**–3]. Further examples are given of the examination of erials in ultra-violet light. The chapter on quantitative measure- ts is new. A bibliography of 890 items is added. L. J. S.

RVAIN (F. de) & GSCHWIND (M.). *Die nutzbaren Gesteine der Schweiz.* Bern (Hans Huber), 1934, xii + 456 pp., 4 pls., 65 text-figs. Price 18 frs. Swiss.

short account of the geology and petrography of all the rocks ilable in Switzerland for building, road-metal, cement-, lime-, brick-making. The rocks are considered in convenient groups their uses are briefly indicated. Chapter VIII reviews the stones t suitable for various purposes. Testing methods are described hapter IX, and colour changes and weathering effects in chapters and XI. Occurrences of gypsum, rock-salt, baryte, fluorite, sphate, magnesite, bituminous shale, and asbestos are described hapter VII, and there is a concluding section on the Alpine eral occurrences and the sadly decreasing industry of mineral ting. Professor P. Niggli contributes an opening chapter which short and interesting introduction to petrography. There are d indexes to localities and subjects. W. C. S.

deposits of the Western States. Lindgren volume. New York (Amer. Inst. of Mining and Metallurgical Engineers), 1933, xxxiv + 797 pp., frontispiece, figs. Price $5.00.

his volume, published in honour of Waldemar Lindgren (born February, 1860) contains contributions by 44 recognized authori-

ties on ore-deposits in the United States. The aim has been to giv the modern views on the ore-deposits of the Rocky Mountains an the Western States of America, but relevant material from othe regions is not excluded. The following headings taken from th titles of the 13 chapters will give some idea of the scope of the work Geology as related to Western mining; Classification of ore deposits Physical-chemical factors; Differentiation and ore deposition; Hydro thermal depth-zones; Relation to stratigraphic, structural, an igneous geology; Mechanism of deposition of certain lode system associated with batholiths: Correlation of kinds of igneous rock with kinds of mineralization; Supergene enrichment; Sedimentar deposits; Genetic groups of hypogene deposits; Utilization of geolog by mining companies; History.

In the chapter on physical-chemical factors in the development a deep-seated type of ore-deposit C. S. Ross gives a brief accoun of his forthcoming work on the paragenesis of the ore-deposits Ducktown, Tennessee, with important conclusions on the segregatio of vein materials and the deposition by hydrothermal solutions carbonates and of the silicates which precede them. N. L. Bowe states the present-day views on differentiation, C. N. Fenner contri butes a section on pneumatolytic processes, and W. T. Schall summarizes recent work on the formation of pegmatites. In a late chapter an account of pegmatites and the useful minerals they co tain (including beryl, columbite, spodumene, &c.) is contributed b F. L. Hess. A life of Waldemar Lindgren with an account of h scientific work is written by L. C. Graton, with a portrait and classified list of his scientific writings. W. C. S.

Precious Stones.

Aloisi (Piero). *Le gemme: trattato sulle pietre preziose.* With a appendix *Sulle perle e sui coralli* by Vincenzo Baldasseron Firenze (Felice Le Monnier), 1932, xix + 409 pp.; 16 pls., 1 text-figs. Price 130 lire.

This is an attractive volume (28 × 20 cm.), well printed on goo paper and with good illustrations (4 of the plates are coloured). is written on much the same lines as Max Bauer's classical work precious stones [M.A. **5**–193], but with much less detail, being i tended more for general readers. L. J. S.

LER (Alfred) † [–1923]. *Edelsteine und Schmucksteine.* 2nd edition by W. Fr. EPPLER. Leipzig (W. Diebener), 1934, 554 pp., 4 col. pls., 317 text-figs. Price 22·50 Mk.

arrangement and scope this book is the same as the first edition 912 [Min. Mag. **16**–306], but it has been entirely rewritten and much improved. There are many new and good illustrations, the four coloured plates are quite effective. A large number of rals suitable for use as gemstones are dealt with in the order of hardness—amber to diamond. L. J. S.

NEWITZ (M. W. *von*). *Precious and semiprecious stones* (*gem minerals*). Minerals Yearbook, 1932–33, Washington (Bureau of Mines), 1933, pp. 799–807.

hese annual reports on precious stones were started in 1882 by . Kunz in the 'Mineral Resources of the United States', and carried on by other authors until 1923. They are now started n with the change from the 'Mineral Resources' to the 'Minerals rbook'. The short chapter in the current volume gives particulars roduction, marketing conditions, and imports into U.S.A., with ort bibliography. L. J. S.

SH (G. A.). *Precious and semi-precious stones.* Mineral Industry, New York and London, 1934, vol. 42 (for 1933), pp. 488–509.

nnual report on production during 1933 [cf. M.A. **5**–397].

RT (Gilbert). *A compilation of gem names.* Minerals and Rocks, Peekskill, N. Y., 1927, vol. 2, pp. 132–135; 1928, vol. 3, pp. 6–7, 52–53, 88–90, 128–129; 1929, vol. 4, pp. 17–19, 48–49, 92–93, 116–117; 1930, vol. 5, pp. 26–27, 64–65, 104–105, 140–141; 1931, vol. 6, pp. 36–37, 81–83.

long alphabetical list of mineralogical, trade, and popular names gemstones. A collected issue in book form of these serial lists, n 1927 to Z in 1931, has been promised, but not yet received. L. J. S.

RT (Gilbert). *The nomenclature of silica.* Amer. Min., 1927, vol. 12, pp. 383–395.

he relations of the crystalline modifications of silica are briefly lained, and a classified list is given of a large number (about 400) ular and trade names, mostly trivial, that have been applied to many varieties and forms of quartz and chalcedony. L. J. S.

Leechman (G. F.). *The semi-precious stones of Cornwall.* Penzanc [1934], 18 pp., 2 col. pls., 4 text-figs. Price 1*s.*

A popular account of quartz varieties, that are to be found pebbles on the beach, by a local lapidary. A brief account of t method of polishing stones is added. L. J. S.

Eppler (W. Fr.). *Der Diamant und seine Bearbeitung.* Leipz (W. Diebener), 1933, 164 pp., 223 figs. Price 10·75 Mk.

This is an interesting and practical handbook on the cutting diamond. The relation of the forms of cutting to the form of t crystal, and its cleavage, hardness, and optical properties are clear explained with the aid of numerous excellent illustrations. Angl and proportions are given for the several facets in the different forn of cutting, to produce the maximum brilliancy by internal tot reflection. The grinding hardness of diamond is least on a cube fa and greatest on an octahedral face [M.A. **3**–437]; in fact, wi diamond powder it is almost impossible to grind strictly parallel an octahedral face. The hardness on each face also varies with t direction of grinding. By the processes of cleaving and brutin crystals are reduced to a form suitable for the grinding wheel. B a greater saving of material and labour in grinding is effected by fir sawing the crystal parallel to a cube face. This is done with a dis of phosphor bronze, 6 cm. in diameter and $\frac{1}{10}$ mm. thick, charged c the edge with diamond powder and rotating at 4000 revolutions p minute. A regularly developed octahedron or rhombic-dodecahedr so cut yields two brilliants, a larger one and a smaller one, each wit the table facet parallel to a cube face of the crystal. Hints are given how to deal with irregularly developed crystals to the best advantag L. J. S.

Robertson (*Sir* Robert), Fox (J. J.), & Martin (A. E.). *Two typ of diamond.* Phil. Trans. Roy. Soc. London, Ser. A, 1934, vo 232, pp. 463–535, 4 pls., 23 text-figs. Abstract in Natur London, 1934, vol. 134, pp. 485–486, 1 fig. [Cf. M.A. **5**–20 213.]

Most diamonds (type 1) show an absorption band in the infra-re at 8 μ and in the ultra-violet at 3000–2250 Å. A few others (type do not show these absorptions, and they are distinguished by a fir lamellar structure parallel to (111), by being more nearly optical isotropic, and in possessing a marked photoelectric effect. The tw types show no difference in colour and clearness, specific gravit

ξ 3·502–3·523), refractive index, fluorescence, Raman effect, &c. y also give the same X-ray pattern but with different intensities, gesting a mosaic structure in crystals of type 2. L. J. S.

SET (James). *Essais d'obtention sous très haute pression de carbone cristallisé.* Compt. Rend. Acad. Sci. Paris, 1934, vol. 199, pp. 144–146.

arbon was formed under varying pressures from 3000 to 25,000 /cm.^{2}: (1) by dissolving it (introduced into the mixture as hite, sugar, or a hydrocarbon) in a metal (Fe, Ni, Ba, Bi, or Ag) luced in situ by the interaction of Al or Mg and the oxide; from a mixture of metallic carbonate (of Fe, Ni, Ba, Ag, Sr, or and Al or Mg; (3) by heating a carbon compound (benzene, ethyl hol, acetone, iron carbonyl, carbon tetra-chloride, -bromide, or de, or disulphide); (4) by the interaction of carbide of Ca, Sr, Ba and a metallic chloride, or of water and silicon carbide; and by heating carbon monoxide. In all cases only graphite or rphous carbon was obtained, though occasionally a minute amount icroscopically crystalline residue remained after application of ordinary methods for isolating diamonds, but too minute to allow etermination of its true nature. C. A. S.

INARD (Ed.). *Les gisements diamantifères et accessoirement aurifères de la région de Bria en Oubangui-Chari.* Ann. Soc. Géol. Belgique, Publ. Congo Belge, 1934, annex to vol. 57, pp. c 65–c 85, 1 pl., 1 text-fig. (maps).

iamond with gold is found in ancient and recent alluvial deposits he basin of the Kotto river north of Bria [M.A. **5**–278]. The els are derived from felspathic sandstones with basal conerates similar to those of the Lualaba-Lubilash series in Belgian go [M.A. **5**–56]. These rocks rest on granite-gneiss and schists, there are no indications of the presence of basic rocks. Associated erals in the gravels are pyrite, corundum, rutile, chrysoberyl, haeite, zircon, tourmaline, garnet, staurolite, and kyanite. L. J. S.

MARÃES (Djalma). *A' margem de "Os sate'lites do diamante".* Monogr. Serviço Geol. Minas Gerais, 1934, no. 2, x + 58 pp., 19 pls.

his is supplementary to E. Hussak's posthumous notes on the ciates of the diamond in Brazil (1917; Min. Mag. **18**–148), colng later information from the literature and adding many new

observations. The several species described are grouped under nor phosphate and phosphate minerals. Then follows an account of th rocks and minerals at each diamond locality, with notes on th genesis of the diamond [M.A. **5**–275–6]. Dennisonite [M.A. **4**–34 from Damasio near Diamantina gave on analysis by J. F. de Andrad after deducting 28·56 % insoluble, P_2O_5 30·33, Al_2O_3 15·15, CaO 41·7 MgO 5·92, Cl 0·22, H_2O 6·67; ω 1·633, ϵ 1·628 (Na). L. J. S.

Aloisi (Piero). *Alcuni diamanti medicei.* Bollettino d'Arte, Rom 1932, ser. 3, vol. 25, pp. 349–358, 10 figs.

An inventory of the jewels of the State of Tuscany was made i 1740 for Anna Maria de' Medici, electress of the Palatinate, the la member of the celebrated Medici family. It includes the 'Florentine or 'Grand Duke of Tuscany' diamond, now in Vienna, of which som historical details are given; also several engraved diamonds, now i the Museo degli Argenti in Firenze (Florence), some of which we listed in the inventory as 'white sapphire?' L. J. S.

Helberger (Hugo). *Kann der Diamant kosmogenetischen Ursprun sein?* [Can diamond be of cosmic origin?] Zeits. Prakt. Geol 1934, vol. 42, pp. 124–125.

The author comments on the occurrence of diamond in meteorite and on the similarity in composition of kimberlite to stony meteorite and, putting two and two together, he suggests that the diamon pipes of South Africa were formed by the penetration of gigant meteorites. L. J. S.

Sun (C. C.). *Notes on the precious stone (beryl, &c.) deposits of Suiyua* Bull. Geol. Soc. China, 1933, vol. 12, pp. 275–282, 2 figs.

The occurrences in the districts of Huanghuakotung and Saili hutung, prov. Suiyuan, are similar to that at Tachingshan [M.A. **5**–36 Pegmatite veins in granite contain globular cavities, 2–3 feet acros the walls of which are lined with crystals of smoky-quartz (12 × inches), beryl (greenish-blue), and topaz. The cavities are partly completely filled with yellowish-red clay in which are embedde some crystals broken from the walls. L. J. S.

Dwyer (E. P.) & Mellor (D. P.). *An X-ray study of opals.* Jour Roy. Soc. New South Wales, 1934, vol. 68, pp. 47–50. [M.A. **5**–381–2.]

Opals associated with igneous rocks show the X-ray patterns β-cristobalite or of α-quartz, and the size of the crystal grains averag

$^{-4}$–10^{-5} cm. Those from sedimentary rocks (at White Cliffs, &c.) w a broad band corresponding with either α- or β-cristobalite, the crystal grains are less than 10^{-6} cm. The persistence of the h-temperature β-form of cristobalite is dependent on its tempera- of formation. L. J. S.

BERSTEIN (G.). *Ein blauer südwestafrikanischer Schmuckstein.* Zeits. Prakt. Geol., 1933, vol. 41, p. 53.

cobalt-blue mineral from the Erongo Mountains, South-West ca, was shown by optical tests to be dumortierite. The mineral formerly supposed to be lazulite, but analysis showed only 0·15% $_2O_5$. [This identification has been confirmed by the abstractor for terial from Etemba farm.] M. H. H.

RDOCH (Joseph). *Amber in California.* Journ. Geol. Chicago, 1934, vol. 42, pp. 309–310.

rown to honey-yellow transparent amber has been found with t remains in clay shale of Eocene age in the Simi valley, Ventura It has H.2½, d 1·06, n 1·545; is partly soluble in ether, and ds succinic acid on distillation. This is the first amber to be nd in California, and it is older than the Baltic amber.

L. J. S.

Meteorites and Tektites.

DE (Fritz). *Kleine Meteoritenkunde.* Verständliche Wissenschaft, vol. 23, Berlin (Julius Springer), 1934, vii + 120 pp., 92 figs. Price 4.80 Mk.

Meteorites have recently been brought into prominence by the blems of geochemistry, meteorite craters, and tektites, and much eral interest has been aroused. A small popular book on the ject is therefore welcome. The present book gives a good and clear ount of the prominent and interesting points, and it is attractively strated, but in most cases there is no indication of the scale of figures. There is a good general account of meteorite craters, on ch the author has previously written [M.A. **5**–408]. A list with tch-map is given of 33 meteorites that have fallen in Germany; ede [M.A. **4**–258] is omitted, and only 32 appear in the world's on p. 46. Still another and incorrect spelling 'Widmann-ttersche Figuren' is given for the etched figures first observed by on Widmanstetter [Min. Mag. **23**–332]. L. J. S.

WAINWRIGHT (G. A.). *Jacob's bethel.* Quarterly Statement, Palestine Exploration Fund, London, 1934, vol. 66, pp. 32–44, 11 figs.

A discussion of the names bethel (Hebrew), *βαίτυλος*, baetylus, and baetyl in connexion with sacred meteorites in ancient times, including Egyptian [M.A. **5**–151, 401]. L. J. S.

FISHER (Willard J.) [1867–1934]. *Mass and velocity of meteorites and the air density along their luminous paths.* Harvard College Observatory Circular, 1934, no. 385, 16 pp., 9 figs.

The surface marking on meteorites indicate a more or less fixed orientation and considerable ablation during flight. With decreasing mass the air resistance relatively increases. L. J. S.

FISHER (Willard J.) [1867–1934]. *Excavated meteorites.* Popular Astronomy, Northfield, Minnesota, 1934, vol. 42, pp. 501–505.

The record to July 1927 is 505 falls and 474 finds of meteorites. Most of the finds have been on the surface or in the soil during ploughing. Only few have been accidentally found in deeper excavations in the subsoil. A list of these is given. The Petropavlovsk iron was found at a depth of 31½ feet in gold-bearing alluvium. [The Klondike (Skookum Gulch) iron was found at a depth of 65 feet in Pliocene gold-bearing gravels.] The numerous irons found in the south-eastern United States are south of the limit of the glacial drift, and the excess is presumably of pre-glacial age. L. J. S.

NININGER (H. H.). *A classification of meteoritic additions to the earth.* Popular Astronomy, Northfield, Minnesota, 1934, vol. 42, pp. 515–518.

The depth at which meteorites penetrate the earth's surface is considered. The following divisions are suggested. (1) Atmospheric additions (dust). (2) Surface residue (not buried). (3) Soil intrusions. (4) Subsoil intrusions. L. J. S.

WYLIE (Charles Clayton). *The temperature of meteorites.* Popular Astronomy, Northfield, Minnesota, 1934, vol. 42, pp. 59–67.

The little available and reliable evidence indicates that stones seen to fall are 'milk warm' to below freezing. Irons, being better conductors of heat, may be hotter, perhaps too hot to handle. Fireballs are seen only at a height of several miles and their molten surface is swept off by the rush of air. The temperature calculated for a rotating black body at the same distance from the sun as the earth is 39° F. L. J. S.

AUX (Lucien). *Les étoiles filantes et la terre.* La Nature, Paris, 1930, vol. 58, sem. 2, pp. 439–443, 7 figs.

Les particules magnétiques recueillies après la pluie météorique du 9 octobre. Ibid., 1933, vol. 61, sem. 2, pp. 436–437, 1 fig.

tmospheric dust collected from melted snow in the Pyrenees and rain-gauge at Donville (Manche) contains minute magnetic cles of globular and cindery forms. It is suggested that these ot all of terrestrial origin (from furnaces, &c.), since they were l in greater amount after the fireball of September 1927 and the shower of October 1933. L. J. S.

HERT (W.) & EHLERS (J.). *Anwendung der Leonhardtschen Methode zur Orientierung von Lauediagrammen bei unbekannter Kristallage auf die Untersuchung der Phosphornickeleisen-Einlagerung im Kamazit.* Zeits. Krist., 1934, vol. 89, pp. 553–559, 4 figs.

onhardt's method [M.A. **3**–533, **4**–122] was applied to the plates osphor-nickel-iron which occur in kamacite from the meteoric of San Martin and Cerros del Buey Muerto. They were found on the (221) faces of the kamacite. H. H.

RLE (Daniel). *Der Meteorit über der Rheinpfalz am 19 Juli 1932.* Jahresber. u. Mitt. Oberrhein. Geol. Ver., 1934, Neue Folge, vol. 23, pp. 1–4.

brilliant detonating meteor was observed at 3·36 a.m. on 19, 1932, at several places in Baden, Pfalz, and Elsass; but ssive search in the wooded districts has not resulted in the finding e meteorite. L. J. S.

LER (E.). *Über die Chemismus des Steinmeteoriten von Lanzenkirchen in Niederösterreich.* Chemie der Erde, 1934, vol. 9, pp. 126–138.

previously published paper [M.A. **3**–394] with some additional ls of the method of analysis. [In the abstract, M.A. **3**–394, the ntage of metal in the darker portion is given incorrectly as instead of 9·33.] L. J. S.

LER (Emil) & SCHADLER (Josef). *Der Meteorstein von Prambachkirchen (Oberösterreich).* Anzeiger Akad. Wiss. Wien, Math.-naturw. Kl., 1933, vol. 70, pp. 249–251; Sitzungsber., Abt. I, 1933, vol. 142, pp. 213–232, 2 pls.

sstone weighing 2125 grams fell at Prambachkirchen (lat. 48° ′ N., long. 13° 56′ 27″ E.) near Eferding in Upper Austria at

21 h. 55 m. on November 5, 1932. A fireball was seen over southe Germany and Austria. An observer 120 m. from the place of fa saw a brilliant light and 43–44 seconds later heard two loud expl sions, and after another 6–8 seconds heard the noise of the fall. Th stone is bun-shaped measuring 130 × 135 mm. with a thickness 75 mm., and it shows a well-marked orientation with flow of materi in the crust from front to back. It is a chondrite of the Baroti ty and closely resembles the Lanzenkirchen meteorite [M.A. 3–394 Sp. gr. 3·583. From partial analyses the bulk composition is Fe 8·3 Ni 0·88, Co 0·07, Fe (as sulphide) 4·88, S 2·80, SiO_2 38·51, TiO_2 0·1 Al_2O_3 3·88, Cr_2O_3 0·05, FeO 12·45, MnO 1·21, MgO 23·46, CaO 2·2 Na_2O 1·16, K_2O 0·23, P_4O_5 0·32, Cl 0·01, Cu, V, Ga, Sc, C traces, tot 100·59, corresponding to nickel-iron 9·27, troilite 7·68, chromite 0·0 ilmenite 0·26, merrillite 0·85, oligoclase and maskelynite 12·37, augi 5·07, olivine (MgO : FeO = 3·5 : 1) 44·49, hypersthene (MgO : FeO = 4 : 20·75 %. Details of the method of analysis are given. L. J. S.

Slavíková (Ludmila). *Druhý kus bohumilického meteorického žele v Národním museu.* [A second mass of the Bohumilice meteo iron in the National Museum.] Časopis Národního Musea, Prah 1933, vol. 107, pp. 82–86, 3 figs.

A mass of iron measuring 23 × 10½ cm. and weighing 5850 gra was found in 1925 at Výškovice, 3½ km. west of Bohumilice Bohemia. It belongs to the Bohumilitz fall, first found in 1829, a is named 'Bohumilice II–Výškovice'. F. S.

Krishnan (M. S.). *The Khanpur meteoric shower.* Rec. Geol. Surv India, 1934, vol. 68, pp. 107–114, 8 pls., 1 text-fig. (map).

A shower of stones was seen to fall between 12 noon and 1 p. on July 8, 1932, at Khanpur (25° 33½′ N. 83° 7½′ E.) and seve neighbouring villages in Ghazipur district, at Kakrapar in Jaunp district, and at Karauli in Benares district, all within a radius 2½ miles in the United Provinces. Two are said to have fallen the roofs of houses, one remaining on top and the other penetrati Twelve pieces with a total weight of 3698 grams (the largest 13 grams) were recovered, but all could not be collected from the nativ Mention is made of one stone of about 30 lb. which was broken by the natives. The stone is a brecciated white chondrite with ch drules of enstatite and olivine, some glass, and grains (up to 9 m across) of troilite [also nickel-iron in small amount]. The spec gravity of different pieces ranges from 3·256 to 3·466. L. J. S.

RRY (Stuart H.). *The San Francisco Mountains meteorite.* Amer. Journ. Sci., 1934, ser. 5, vol. 28, pp. 202–218, 16 figs.

An iron of about 1700 grams was found about 1920 on the northern pes of the San Francisco Mts., near Flagstaff, in Arizona. It has ooth convex surfaces and a well-marked fusion crust, and it was dently a recent fall. Analysis by F. A. Gonyer gave Fe 91·91, 7·83, Co 0·16, Cu 0·03, insol. (Fe_2O_3) 0·03 = 99·96; sp. gr. 7·87. e structure is that of a finest octahedrite, and there is an exterior ating zone, 2·5–10 mm. thick, of granulated kamacite. A detailed tallographic description with photomicrographs of high magnifi- ion is given. L. J. S.

RRY (Stuart H.). *The Cherokee Springs meteorite.* Popular Astronomy, Northfield, Minnesota, 1934, vol. 42, pp. 349–357. 12 figs. [Cf. M.A. **5**–405.]

After three or four detonations and a noise like that of an air- ne, a stone of 5·7 kg. fell at 9.42 a.m. on July 1, 1933, at Cherokee ngs, Spartenburg Co., South Carolina, making a hole 15–18 inches p in sandy soil and bouncing out again to a distance of 15 inches. en picked up immediately afterwards it was too hot to handle fortably. A smaller stone of 2·7 kg. fell 6½ miles north by east. stones are prismatic in form with smooth surfaces and no minent pitting. They approximately fit together and show areas secondary crust. The material is light grey with a coarsely ndritic structure, the chondrules, which break with the matrix, ng up to 10–12 mm. across. Olivine, enstatite, clinoenstatite, rthite, troilite, nickel-iron, and chromite are present. An analysis R. R. Kountz, SiO_2 24·55, Fe_2O_3 40·03, Al_2O_3 12·19, NiO 15·40, O 1·43, MgO 5·17, Na_2O,K_2O 1·23 = 100·00 [is obviously incorrect]. L. J. S.

LLISON (James S.) & MUILENBURG (Garrett A.). *A newly found meteorite from Lanton, Howell County, Missouri.* Journ. Geol. Chicago, 1934, vol. 42, pp. 305–308, 2 figs.

Four rusted fragments of iron with a total weight of 13,780 grams, re found in 1932 close together on the surface of the ground. e piece easily broke into several fragments, and it is suggested t the separation of the fragments was due to rusting along the tahedral planes. The bands of kamacite in the lamellar octa- ral structure have an average width of less than 1 mm. Analysis

by W. T. Schrenk and W. B. Banforth gave Fe 90·40, Ni 8·33 Co 0·61, P 0·18, SiO_2 0·005, Mn, Cu nil = 99·525. L. J. S.

Henderson (Edward P.). *Two new meteoritic irons from New Mexico the Grant meteorite and the Santa Fe meteorite.* Popular Astronomy, Northfield, Minnesota, 1934, vol. 42, pp. 511–515, 4 figs.

The Grant meteorite was found about 1929 in the Zuni Mts. 45 miles south of Grant, Valencia Co., New Mexico. It is a conical shaped mass of iron weighing 1060 lb. with moderately fine octahedral structure and inclusions of troilite and schreibersite; analysis I. The Santa Fe meteorite was found about 1930 fourteen miles east of Santa Fe, Santa Fe Co., New Mexico. It is a club-shaped mass of iron weighing 23 lb. with fine octahedral structure and no visible inclusions; analysis II. Both masses are preserved in the United States National Museum at Washington, D. C.

	Fe.	Ni.	Co.	Cu.	Pt.	P.	S.	C.	Insol.	Total
I.	89·45	8·58	0·011	trace	nil	1·15	0·02	0·002	0·046	99·25
II.	94·75	4·64	0·32	trace	—	0·23	0·04	—	0·001	99·98

L. J. S.

Nininger (H. H.). *A gold-bearing stony meteorite from Melrose, New Mexico.* Amer. Min., 1934, vol. 19, pp. 370–374, 1 fig.

A much-weathered meteoric stone weighing 31 kg. was ploughed up some years ago at Melrose, [Curry Co.], and in 1933 four stones with a total weight of 20·382 kg. were found on the surface near La Lande, [Roosevelt Co.], 26 miles to the west. They are to some extent chondritic, and are all believed to belong to the same fall. Analysis by F. G. Hawley of the metallic portion (0·44 %) gave Fe 89·1, Ni 9·2, Co 1·5, Cu 0·02 %; and of the non-metallic portion SiO_2 35·90, TiO_2 0·12, Al_2O_3 2·20, Cr_2O_3 0·56, Fe_2O_3 12·03, FeO 16·13, NiO 1·23, CoO 0·08, MnO 0·29, MgO 22·15, CaO 2·35, Na_2O 0·29, K_2O 0·08, SO_3 0·35, Cl 0·06, P_2O_5 0·22, FeS 4·95, H_2O 1·16, total 100·15; platinum metals 0·24 oz. per ton, gold 0·02–0·32 oz. per ton [0·00007–0·001 %]. L. J. S.

Nininger (H. H.). *The Roy aërolite.* Popular Astronomy, Northfield, Minnesota, 1934, vol. 42, pp. 599–600.

A weathered stone was found in 1933 partly embedded in grazing land 11 miles east of Roy, Harding Co., New Mexico (35° 56′ N. 104° W.). It was broken into fragments by the finder who hoped to

precious metals; 104 lb. of these fragments have been recovered. ysis by F. G. Hawley gave SiO_2 36·95, TiO_2 0·12, Al_2O_3 2·92, $_3$ 0·43, Fe_2O_3 13·29, FeO 12·57, NiO 1·27, CoO 0·14, CuO 0·10,) 0·16, MgO 23·10, CaO 2·50, Na_2O 0·26, K_2O 0·06, SO_3 0·69, , 0·31, FeS 3·58, ign. loss 1·88 = 100·33. Pt. metals 0·05 oz. per Au nil. L. J. S.

NGER (H. H.) & FIGGINS (J. D.). *The excavation of a meteorite crater near Haviland, Kiowa County, Kansas.* Proc. Colorado Mus. Nat. Hist., 1933, vol. 12, no. 3, pp. 9–15, 3 pls.; abstract in Amer. Journ. Sci., 1934, ser. 5, vol. 28, pp. 312–313, 1 fig. xcavation of a swampy depression ('buffalo wallow') measuring 10·7 m. yielded a large number of limonite nodules [M.A. **4**–264, scattered over a funnel-shaped area. The larger nodules were H in the centre at a depth of about 3 m.; these still contain a of nickel-iron and olivine of the type of the Brenham pallasite. ve the nodules was stratified sandy clay. It is suggested that unnel was formed by the cushion of compressed air in front of alling meteorite or cluster of meteorites. L. J. S.

LEY (Earle G.). *A description of the meteorites available for public inspection in the San Francisco Bay region.* Popular Astronomy, Northfield, Minnesota, 1934, vol. 42, pp. 472–477.
list is given of eight meteorites recorded from California. A kg. mass of the 'Carleton' (= Tucson) iron is preserved in San isco. L. J. S.

SON (D.). *The Arltunga and Karoonda meteorites.* Trans. Roy. Soc. S. Australia, 1934, vol. 58, pp. 1–6, 3 pls.
e Arltunga iron weighing 40 lb. was found in 1908 two miles of the Government Cyanide Works in Central Australia 28′ S., 134° 40′ E.). It had cut a groove 5 feet deep in the nd, and was evidently a recent fall. Analysis by W. T. Chapman Fe 88·06, Ni 10·22, Co 1·01, Cr 0·26, P 0·24, S not det., insol. = 99·80; sp. gr. 7·848. A polished and etched surface shows sted appearance suggesting an ataxite, with a few specks of reelite and schreibersite, but under a high magnification a micro- edral structure is seen, suggesting a recrystallization of the rial due to heating. The material of the Karoonda meteorite . **5**–15] is dark grey and friable. Analysis by A. R. Alderman

gave SiO_2 34·66, TiO_2 trace, Al_2O_3 5·55, Cr_2O_3 0·49, FeO 26·9
MnO 0·21, MgO 24·85, CaO 2·58, Na_2O 0·71, K_2O 0·26, P_2O_5 0·2
H_2O 0·13, FeS 3·98, Fe 0·42, Ni 0·02, C 0·08 = 100·88, sp. gr. 3·
corresponding with olivine (and some hypersthene) 82, melilitic an
felspathic portion 12, troilite 3·98, chromite 0·67, apatite 0·6
nickel-iron 0·44, amorphous carbon 0·08. The abundant chondrul
of olivine break away from the fine-grained brecciated matrix. Th
stone is classed as a chondritic asiderite. L. J. S.

Astapowitsch (I. S.). *Air waves caused by the fall of the meteorite o 30th June, 1908, in central Siberia.* Quart. Journ. Roy. Meteoro logical Soc. London, 1934, vol. 60, pp. 493–504, 5 figs.

Whipple (F. J. W.). *On phenomena related to the great Siberia meteor.* Ibid., pp. 505–513, 1 fig.

Further notes on barograph records and illumination of the sk [M.A. **4**–428]. L. J. S.

Spencer (L. J.). *Meteorite craters.* Proc. Geol. Assoc. Londo 1934, vol. 45, pp. 407–411.

Report of a demonstration in the meteorite collection of the Britis Museum of Natural History to members of the Geologists' Associa tion [M.A. **5**–150, 301]. L. J. S.

Melton (F. A.). *The origin of the Carolina "bays".* Discover London, 1934, vol. 15, pp. 151–154, 5 figs.

Summary of a previous paper [M.A. **5**–303], giving arguments i favour of the meteoritic theory, but stating possible flaws.

L. J. S.

Cooke (C. Wythe). *Discussion of the origin of the supposed meteori scars of South Carolina.* Journ. Geol. Chicago, 1934, vol. 4 pp. 88–96, 6 figs.

Melton (F. A.). *Reply.* Ibid., pp. 97–104.

The elliptical scars [M.A. **5**–303] have a length of $\frac{1}{4}$ to 2 mile but the rims are only about 5 feet high. They are thus quite distin from known meteorite craters. It is believed that they are bea ridges and bars formed in extinct lakes or lagoons, and that the uniform orientation is due to wind blowing from the sea. In th reply the meteoritic theory is still adhered to, but if this fails su marine scour is suggested. L. J. S.

INGER (H. H.). *The Odessa, Texas, meteorite crater.* Popular Astronomy, Northfield, Minnesota, 1934, vol. 42, pp. 46–47.

A piece (300 grams) of meteoric iron was picked up on the rim of crater, and by combing the soil with an electromagnet many all fragments of iron and rust were collected. L. J. S.

INGER (H. H.). *"Meteor craters" vs "steam blowouts".* Mines Magazine, Colorado School of Mines Alumni Association, Golden, Colorado, 1933, vol. 23, pp. 7–9, 10–11, 1 fig.

Arguments for the formation of craters by the fall of large eorites, as opposed to the volcanic theory. L. J. S.

OT (E.). *Le mystère des tectites, larmes bataviques* [Prince Rupert's drops] *tombées du ciel.* Revue Scientifique, Paris, 1933, ann. 71, pp. 577–581, 7 figs.

A review of A. Lacroix's monograph reproducing some of the res [M.A. **5**–303]. The known occurrences of tektites lie along a at circle inclined at 50° to the equator [M.A. **3**–538], and it is gested that tektites are the fragments of a satellite X_3 which fell he earth in Tertiary times. L. J. S.

ROIX (A.). *Nouvelles observations sur la distribution des tectites en Indochine et dans les pays voisins.* Compt. Rend. Acad. Sci. Paris, 1934, vol. 199, pp. 6–9.

Further localities for tektites are recorded in Tonkin, Laos, and mbodia in French Indo-China, and in Kwang-Chow-Wan and Hai- in south China [M.A. **5**–18, 303]. Around the massif of Pia Oac Tonkin they are found in tin-bearing gravels. A new find is in m in ancient alluvials at Phuphan Hill in prov. Nakon Panom rdering on French Laos). L. J. S.

DGE-SMITH (T.). *Tektites.* Australian Museum Mag. 1934, vol. 5, pp. 225–227, 7 figs.

A short popular article with mention of the various theories of the in of tektites. Although the evidence for the meteoric origin is ative, it is suggested that the thousand meteorites already known perhaps not samples of all the different kinds of material of the nty-five million meteors that enter the earth's atmosphere every . L. J. S.

Fenner (Charles). *Australites, part I. Classification of the W. H. C Shaw collection.* Trans. Roy. Soc. South Australia, 1934, vol. 58 pp. 62–79, 6 pls., 4 text-figs.

The australites (3920 specimens) described were collected on th arid limestone Nullarbor Plain between Eucla and Israelite Bay i Western Australia. They are grouped according to form as: buttons lenses, ovals, boats, canoes, dumbbells, and teardrops; and each o these groups is subdivided according to size. The largest specime weighs 218 grams and the smallest 0·15 gram, the average weigh being 0·934 gram. The surface characters, flanges, rims, and flo ridges are described, and suggestions made as to their origin. Th forms are compared with those of 'smoke bombs from railwa engines'. It is concluded that these australites are glass meteorite and that they all fell at one time. L. J. S.

Fenner (Charles). *Bunyips and billabongs, an Australian out of doors* Sydney (Angus & Robertson), 1933, xvi + 241 pp., figs. Price 6s

A collection of popular newspaper sketches. Chapter II (pp. 34 48) contains articles entitled: Falling stars and fireballs; Australite or 'Blackfellows' buttons', Fulgurites and lightning flashes.

L. J. S.

Janoschek (Robert). *Das Alter der Moldavitschotter in Mähren* Anzeiger Akad. Wiss. Wien, Math.-naturw. Kl., 1934, vol. 71 pp. 195–197.

The moldavite-bearing gravels of Moravia lie at 60–100 m. abov the valley bottoms in which are Quaternary clay and loess. The are correlated with the *Oncophora* sands of the Helvetian Stage of th Miocene, and are thus much older than the tektite-bearing gravels o Indo-China and Australia, which are certainly not pre-Pleistocene The suggestion that tektites are distributed on a great circle of th earth [M.A. **3**–538] and are all of the same age is therefore invalidated

L. J. S.

Němec (František). *Druhé sklo s povrchem vltavínovým z Třebíče.* [second glass with moldavite-like surface from Třebíč.] Příroda Brno, 1933, vol. 26, pp. 259–261, 1 fig.

Close to one of the moldavite localities near Třebíč in Moravia ha been found a piece of violet glass weighing 3·12 grams with sp. g 2·626 and n 1·548. The surface markings (shallow circular pits) ar like those on the moldavites found at Třebíč, which suggests that th markings on moldavites are also due to chemical corrosion. F. S.

ss (E.). *Chrom und Nickel in Tektiten.* Die Naturwissenschaften, 1934, vol. 22, p. 480.

ectrum analysis showed in moldavite Cr_2O_3 0·01, NiO 0·002%, in alite 0·03 and 0·005, in billitonite 0·15 and 0·04, and in silica- from the Henbury meteorite craters 0·03 and 0·3 respectively. results do not support the theory that tektites have any on with meteorite craters. L. J. S.

(G.). *Über den Tektit von Paucartambo.* Centr. Min., Abt. A, 934, pp. 13–15.

eply to E. Dittler [M.A. **5**–304] and repetition of earlier papers **3**–97, 539]. L. J. S.

(G.). *Tektite.* Handwörterbuch der Naturwissenschaften, nd edition, 1934, vol. 9, pp. 901–906, 19 figs.

eneral review, giving prominence to the supposed tektite from rtambo, Peru [M.A. **3**–97, 539]. L. J. S.

N (R.). *Are the "americanites" tektites?* Leidsche Geol. Mede- Heelingen, 1934, vol. 6, pp. 123–132.

eview of the literature on the supposed tektites from Colombia ru [M.A. **3**–538–539] and of the arguments for and against a or terrestrial origin. The weight of the evidence suggests ey are obsidian bombs rather than tektites. L. J. S.

Rock-forming Minerals and Petrology.

(E.). *Beitrag zur Kenntnis der Dispersion der Kalknatronfeld- äte.* Zeits. Krist., 1934, vol. 89, pp. 49–79, 18 figs.

principal refractive indices, positions of the optic axes, and xial angle were determined for six varieties of plagioclase and ve-lengths 688, 589, 486 $\mu\mu$. H. H.

(Hisashi) & Sawatari (Mititaka). *On the augites from Wadaki, lu, and from Yoneyama, Etigo, Japan.* Japanese Journ. Geol. eogr., 1934, vol. 11, pp. 327–343, 7 figs.

tals of augite from volcanic tuffs show zonal structures with t decrease in the optic axial angle, refractive indices, and ion-angle from the core to the exterior, indicating a variation nical composition. Bulk analyses I and II by S. Tanaka. I, Vadaki: sp. gr. 3·349, α 1·680–1·698, β 1·687–1·704, γ 1·706–2V 56·2°–60·9°; $c : \gamma = 40·5°–44·5°$. II, from Yoneyama:

α 1·684–1·700, β 1·692–1·708, γ 1·707–1·721; 2V 52° 18′–57° 55
$c : \gamma = 37·1°–47·9°$.

	SiO_2.	TiO_2.	Al_2O_3.	Fe_2O_3.	FeO.	MnO.	MgO.	CaO.	H_2O+.	H_2O
I.	49·86	0·41	5·48	2·42	4·23	0·15	15·02	22·34	0·20	0·11
II.	50·10	0·70	4·57	2·34	7·14	0·32	14·20	20·18	0·24	0·10

II, also Na_2O 0·32, K_2O trace, P_2O_5 trace.

L. J. S.

[Loewinson-Lessing (F. Y.) & Diakonova-Savelieva (E. N. Левинсон-Лессинг (Ф. Ю.) и Дьяконова-Савельева (Е. Н. Вулканическая группа Карадага в Крыму.—Loewinson-Lessi (F. Y.) et Diakonova-Saveliéva (E. N.). *Le groupe paléovol nique du Karadagh en Crimée.* Петрогр. Инст. Акад. Наук СС Ленинград (Petrogr. Inst. Acad. Sci. U.S.S.R. Leningrad), 193 151 pp., 69 figs., 1 map. (Russ. with French résumé.)

The volcanic complex of Karadagh (20 km. SW. of Theodosia) described and 72 new chemical analyses are included. Three volca cycles are suggested. The first cycle is only represented by fra ments of an acid palaeoliparite in the volcanic agglomerate belongi to the second cycle. The second cycle is represented by lavas, int bedded tuffs, and agglomerates. The rocks belong to the palaeoty series (in the sense of Brögger) and comprise sodic types, rangi from basic to acid in order of extrusion. They include spilit keratospilites (new type), keratophyres, oxykeratophyres [M.A. **4**– and palaeoliparites. The third cycle is represented by intrusi plugs, dikes, and sills, the rocks belonging to an alkali-poor cenoty series, also ranging from basic to acid in order of intrusion: basal andesito-basalts, andesites, dacites, liparito-dacites, and liparites. T so-called 'trass' used for the manufacture of cement is not a t but a liparite lava (partly autobrecciated). The pillow-lavas (spilit keratospilites) are well represented, and their submarine origin suggested. The problems of the spilitic suite and of the magma differentiation are discussed. A mixing of two primary magn (basic and acid) is suggested to explain the variation of rock-type

S. I. T.

Lacroix (Alfred). *Contribution à la connaissance de la composit chimique et minéralogique des roches éruptives de l'Indochine.* Bu Service Géol. Indochine. 1933, vol. 20, fasc. 3, 208 pp., 6 p 4 text-figs. (maps).

This is a treatise of the greatest importance to all petrograph as it contains in an introduction a brief statement of Prof. Lacroi

keral conceptions of petrology in so far as these affect classification eruptive rocks and their nomenclature, and also an appendix out- ng his scheme of classification which is further explained in a series ables. The scheme is mineralogical, qualitative and quantitative, pported by a chemical-mineralogical classification of magmas based the Cross-Iddings-Washington-Pirsson system. Space forbids our ing an outline of the classification in this abstract. The introduc- n and appendix have been issued as a 'separate' apart from the criptive matter, and, with its very full index of rock-names and ns employed, it provides a key to the author's numerous and portant contributions to systematic petrography.

The rocks described are pre-Tertiary eruptive rocks, and post- ttiary basaltic lavas from Annam, Cambodia, Cochin China, Laos, kin, and Yunnan, and a final chapter gives a brief account of e eruptive rocks from the Malay States, Banka and Billiton, matra, and north-eastern China. There are 246 chemical analyses, which 132 have not been published previously.

ome account is given of veins carrying cassiterite and wolframite Pia Oac, 65 km. W. of Cao Bang, Tonkin; and at two localities aos and in Yunnan; with analyses I and II of wolframite, III, nerite, and IV, scheelite.

	WO_3.	MoO_3.	FeO.	MnO.	CaO.
I.	76·54	—	16·98	5·64	0·84
II.	76·49	—	13·69	9·82	—
III.	76·45	—	2·06	21·49	—
IV.	80·24	0·47	—	—	19·64

he plates contain photographs of fine crystals of scheelite, wolfra- e, apatite, and cassiterite; and photomicrographs of stannite, de, pyrrhotine, chalcopyrite, and scorodite. Other minerals rded include autunite, fluorite, molybdenite, rhodochrosite, and ve bismuth. W. C. S.

TU (Shukusuké). *The great activity of Komagataké in 1929.* Min. Petr. Mitt. (Tschermak), 1934, vol. 45, pp. 133–174, 26 figs.

he eruption of the volcano Komagataké (= horse mountain) in v. Oshima, Japan, on June 17, 1929, gave a large amount of newly ned dacite pumice which fell as a 'pumice-flow' on the sides of mountain and as a 'pumice-fall' of finer material over a wider . The pumice (anal. I) contains crystals of plagioclase (anal. II), ersthene (α 1·698, β 1·706, γ 1·713, 2V 60–66°, anal. III), augite 691, β 1·697, γ 1·718, $c:\gamma = 43°$, 2V 51–66°, anal. IV), and

magnetite in a glassy base (n 1·494–1·497, anal. V). The last form 44·88 % of the rock. Some inclusions of a cordierite-rock and a dacit veined with anhydrite and magnetite are also present. Heated a 450° C. the 'pumice-flow' yields much more HCl than the 'pumice fall'. The thermal expansion of the compact glassy rock was deter mined; at 850° C. it expands explosively and is changed into pumice The 'pumice-flow' retained heat for a long period, and small fuma roles on its surface deposited salammoniac. The ammonia for thi was probably formed from atmospheric nitrogen during the lightnin discharges produced by the eruption.

	SiO_2.	TiO_2.	Al_2O_3,	Fe_2O_3.	FeO.	MnO.	MgO.	CaO.	Na_2O.	K_2O.	H_2O
I.	61·41	0·46	15·42	2·64	4·93	trace	2·34	6·70	4·72	1·10	0·54
II.	54·09	trace	27·27	0·35	0·40	trace	0·62	10·22	4·52	1·51	0·32
III.	51·33	0·87	0·45	0·83	19·40	0·09	25·04	1·03	0·43	0·18	0·55
IV.	50·40	1·13	1·63	2·06	9·74	0·09	13·37	20·65	0·66	0·23	0·51
V.	74·07	0·32	12·61	1·39	0·67	trace	0·25	4·49	5·37	0·91	0·46

L. J. S.

[Sobolev (Vladimir)] Соболев (Владимир). Кварц-фаялитовый диабаз пегматит (река н. Тунгуска.) *Quartz-fayalite diabase-pegmatit (Lower Tunguska)* Зап. Всеросс. Мин. Общ. (Mém. Soc. Russ Min.), 1933, ser. 2, vol. 62, pp. 493–509, English summary pp. 509–511.

A coarse-grained diabase-pegmatite with prismatic-ophitic textur contains 8 % of olivine as acicular or tabular grains which giv $\alpha > 1{\cdot}771$ $< 1{\cdot}825$, β near 1·825, $\gamma - \alpha = 0{\cdot}045$, 2V 60°, negative Optical data are thought to correspond to fayalite with about 80 % Fe_2SiO_4. W. C. S.

Yoshiki (Bumpei). *Petrographic notes on the orbicular rock fro Minedera-yama.* Proc. Imp. Acad. Tokyo, 1933, vol. 9 pp. 609–612, 1 fig.

Kawano (Yoshinori). *Chemical studies of the orbicular rock fro Minedera-yama.* Ibid., pp. 613–616, 1 fig.

A lenticular mass of orbicular rock measuring about 5 by 2 metre is exposed on the cliff face of Minedera-yama, near Tokyo, Japa The enclosing rock is a porphyritic biotite-granite, and the orbicula rock is due to the inclusion and metamorphism of fragments of Palaeozoic slate. The spheroids consist of a dark grey kernel biotite and oligoclase in the proportion of 68 : 32, and showin schistose structure; an outer light grey shell of radiating crysta

ordierite with small amounts of biotite, muscovite, and oligo-
, and a very thin dark, fine-grained, outer zone of oligoclase,
te, and quartz. The matrix is granitic in texture and consists
uartz, oligoclase, biotite, and muscovite, but is much richer in
tz than the normal granite, its silica percentage being 81·37 %.
nical analyses of the unmetamorphosed slate, and of the kernel,
shell, and matrix of the orbicular rock indicate that the slate
l supply all the material for the biotite and oligoclase of the
l and also contribute some SiO_2 and K_2O to the invading
te melt. Oligoclase and biotite from the kernel of one of the
oids were separated and analysed. The composition of the
te is SiO_2 33·73, TiO_2 2·45, Al_2O_3 19·37, Fe_2O_3 3·28, FeO 16·38,
0·29, MgO 8·99, CaO 0·16, Na_2O 1·30, K_2O 7·83, H_2O+ 3·98,
– 2·31, P_2O_5 0·12, total '100·07'. The optical properties of this
are α 1·578, β 1·630, γ 1·633, 2V 7°; pleochroism, pale to deep
. The anorthite-content of the oligoclase calculated from the
sis is 21·9 % with only 0·12 % K_2O. W. C. S.

RS (T. W.). *Alkali-rocks in the Auas Mountains, south of Windhoek, S.W.A.* Trans. Geol. Soc. South Africa, 1934, vol. 36 (for 1933), pp. 77–88, 2 pls.

ny small dikes, sills, and plugs of trachytic and phonolitic
have been discovered in this area. Phonolites and tinguaites
escribed in some detail, with two chemical analyses of fresh
nalcimized varieties. Other rocks, described very briefly, are
kinite, limburgite, alkali-peridotite, biotite-trachyte, aegirine-
yte. S. J. S.

D (S. J.). *The heavy minerals of kimberlite.* Trans. Geol. Soc. South Africa, 1935, vol. 37 (for 1934), pp. 57–68.

the first part of this paper the writer discusses the available
relating to the composition of the pyroxenes in kimberlite, and
s that they may all be referred to four types, as follows: (*a*)
ightly ferriferous enstatite or bronzite; (*b*) members of the
tite-diopside series ranging from nearly pure diopside to
ties containing as much as 35 % of enstatite molecules, and in-
ng the so-called 'chrome-diopside'; (*c*) augite, forming a rare
scopic constituent; (*d*) members of the jadeite-diopside series,
reported but not fully authenticated. In the second part the
r gives the result of an investigation of the concentrates from

the pulsator. The concentrate is shown to consist mainly of ro fragments and grains of ilmenite, the other minerals observed bei pyrite, marcasite, garnets, enstatite, chrome-diopside, pale gre diopside, actinolite, zircon. Jadeite-diopside was not found, neith was smaragdite, and olivine was absent from all except one select sample of the coarser concentrate. As a result of this examinati the writer concludes that the contribution made by garnetifero rocks (eclogite and related types) to the composition of kimberlite about one part in a thousand. The so-called eclogite enclosures kimberlite are different from the original eclogite of Bavaria, bei mainly enstatite-garnet-rocks with subordinate diopside, olivine, a ilmenite; it is suggested that the name griquaite, given to the rocks by R. Beck, is more appropriate than eclogite. The endogeno minerals of the kimberlite magma are olivine, serpentine, phlogopi ilmenite, perovskite, and sometimes augite; all the other miner named have been derived from enclosures of foreign rocks.

S. J. S.

Perrin (R.). *Sur le métamorphisme.* Compt. Rend. Acad. S Paris, 1934, vol. 198, pp. 2005–2008.

When slags attack the lining of a furnace there is not mere penetration of the slag as such into the materials of the lining, b actual interchange of constituents, which may result in a lowering the melting-point. It is suggested that similar processes at the co tact of molten magmas with solid rock explain, at least in part, t phenomena of metamorphism. C. A. S.

Flett (*Sir* John). *A thomsonized* [sic] *inclusion from the Blackness s* Summ. Progr. Geol. Surv. Great Britain, 1934, for 1933, pt. pp. 85–90, 1 pl.

A xenolith caught up in a teschenite sill 164 feet thick at Blackne West Lothian, has been contact metamorphosed, fused and render vesicular, and largely replaced by thomsonite. The xenolith n consists of a matrix of thomsonite as crystals nearly $\frac{1}{2}$ inch in leng with embedded grains of pyroxene, garnet, sphene, and iron-or The source of the xenolith is believed to be the Houston Marl, wh lies below the sill and is shown to be fusible to a vesicular mass 1310° C. The teschenite was found to soften at 1160° and fuse 1245° C., and for the picritic part of the same sill the correspondi temperatures were 1230° and 1300° C. W. C. S.

KOLA (Pentti). *Prehnite amygdaloid from the bottom of the Baltic.* Compt. Rend. Soc. Géol. Finlande, 1934, no. 8, 13 pp., 7 figs.

Four boulders of prehnitized amygdaloidal basalt were found in collection of glacial boulders from Hasau, Courland, and two similar boulders are recorded from East Prussia. The prehnite occurs chiefly in irregular nodules representing original amygdules, but also replaces the plagioclase of both phenocrysts and groundmass. In the amygdules it is associated with epidote and analcime. The alteration of the basalt is believed to be due to autohydrothermal metasomatism, the additional lime for the prehnite being carried by carbon dioxide as calcium bicarbonate. The lime may have been derived from the inversion of anorthite to albite. An analysis of one of the boulders is given. The prehnite is optically positive, 2V large, α 1·612 ± 0·001, β 1·640 ± 0·001. Small pseudomorphs of iddingsite after olivine show that in some crystals parallel to the cleavage, in others perpendicular, but these two orientations are occasionally observed at opposite ends of the same crystal. W. C. S.

LEIGH (*Lord*). *The bending of marble.* Proc. Roy. Soc. London, Ser. A, 1934, vol. 144, pp. 266–279, 1 pl., 3 text-figs.

A slab of Carrara marble after heating at 100° C. shows a slight increase in length and it can then be bent by a side pressure; after heating at 350° C. these results are much more appreciable. A slab heated on one side only becomes warped. This is attributed to the unequal expansion of the calcite grains in different crystallographic directions and the consequent loosening of the interlocking structure. L. J. S.

. (W.). *Zur Genesis porphyrischer Struktur in Gipsgesteinen.* Chemie der Erde, 1934, vol. 9, pp. 1–21, 8 figs.

Massive gypsum spotted with porphyritic crystals of gypsum is described from several localities. The phenocrysts are due to recrystallization of the material. L. J. S.

DJE (Otto). *Gewinnung und Untersuchung der Meeresgrundproben.* Handbuch der biologischen Arbeitsmethoden, herausg. von Emil Abderhalden, Abt. IX, Methoden der Erforschung der Leistungen des tierischen Organismus, Teil 6, Heft 3, Berlin & Wien (Urban & Schwarzenberg), 1933, pp. 377–542, 64 text-figs. Price 9·20 Mk.

A useful account of the methods of collecting, preserving, and investigating oceanic deposits with much information bearing on the

study of sediments, e.g., mechanical analysis, methods of mineralogical and chemical determinations, investigation of radioactivity recognition of organic remains, and methods of embedding and hardening sediments for slicing. The tables include one giving densities and refractive indices of minerals and densities of some rocks. W. C. S.

Björlykke (Harald). *Über die Anwendung von Sorelzement zur Herstellung mikroskopischer Dünnschliffe von Mineralböden usw.* Chemie der Erde, 1934, vol. 9, pp. 50–51.

The mineral grains are added to a thick paste made on a slide by mixing MgO powder with a concentrated solution of $MgCl_2$. This sets to a hard cement in about two days, and the section can then be prepared in the usual way. An examination of the weathering of different grains is thus possible. L. J. S.

Economic Minerals and Ore-deposits.

Kiessling (O. E.). *Minerals Yearbook 1932–33.* U.S. Department of Commerce, Bureau of Mines, Washington, 1933, xiii + 819 pp. 90 figs. Price $1·25 (cloth).

This is a continuation of the 'Mineral Resources of the United States', which was started by the U.S. Geological Survey as annual volumes for the year 1882 (issued 1883). The two volumes for 1925 (1926–1927) were the last issued by the Geological Survey; and later volumes up to 1931 (1933) were issued by the Bureau of Mines. The present volume for the two years 1932–1933 is on the same lines as before but more condensed, forming a single volume instead of two. Part I gives a short statistical summary, Part II metals, and Part III non-metals, the several chapters in each being contributed by different authors. Statistical tables and graphs are given.

L. J. S.

Adams (Frank Dawson). *Origin and nature of ore deposits: an historical study.* Bull. Geol. Soc. Amer., 1934, vol. 45, pp. 375–424, 1 pl.

An historical review from the time of Aristotle to the Middle Ages with a chapter 'The transition to modern views', and a concluding chapter 'In how far has modern science advanced toward a true understanding of the subject'. L. J. S.

PNER (Armin). *Sammelreferat der zwischen 1918 und 1931 rschienenen deutschsprachigen Literatur über deutsche Goldvorkommen.* Min. Petr. Mitt. (Tschermak), 1934, Ref. vol. 2, pp. 409–432, 1 fig. (sketch-map).

eview is given of the literature for the period 1918–1931 on ccurrence of gold in Germany. An unsuccessful attempt was in 1926 to work the low-grade ores. L. J. S.

P (A. E.). *The geology of the Lower Gwanda gold belt.* Bull. eol. Surv. Southern Rhodesia, 1933, no. 24, 74 pp., 3 pls., map. Price 2*s.* 6*d.*

s is one of the smaller belts of Basement Schists, situated about iles south of Bulawayo. It is entirely surrounded by prerian granite. The schist series includes all the usual types of schist and banded ironstone. The majority of the gold reefs artz bodies with pyrrhotine and pyrite, but in the New Mystery mustard gold', consisting of minute cubic crystals and plates, en deposited in the cleavage planes of hornblende crystals. ory minerals in the reefs are bismuthinite, tetradymite, stibnite, denite, with limonite and manganese oxides. Other minerals ered in the area are chloanthite, niccolite, and chrysotile.

S. J. S.

FOOT (B.). *The larger gold mines of Southern Rhodesia.* Bull. eol. Surv. Southern Rhodesia, 1934, no. 26, 106 pp., 2 figs. rice 1*s.* 3*d.*

gold ores of Southern Rhodesia are found in narrow belts of which lie like islands in a sea of granite. The strike of the s nearly always parallel to the schistosity of the country-rock. lodes considered in this bulletin, 73 are pyritic quartz veins, pyritic impregnations along shatter belts, 6 are antimonial gnations, 4 are antimonial quartz veins, and 1 is a cupriferous vein. A summary is given of the history, geology, develop- and output of 100 out of the 3,500 gold mines of Southern sia. S. J. S.

SSON (J. C.). *The geology of the country around Filabusi, Insiza strict.* Bull. Geol. Surv. Southern Rhodesia, 1934, no. 27, 9 pp., 21 pls., 1 map. Price 5*s.*

busi, 53 miles ESE. of Bulawayo, is the centre of an important elt. The geological formations present belong to the Basement and include a quartz-schist group, a greenstone group, and a

phyllite group. These ancient rocks are cut by great intrusions granite, and both the schists and the granite are cut by dolerite dik Other intrusive igneous rocks are a plug of rhyolite and a dike limburgite. Sixty pages are devoted to the petrology of these roc many complete chemical analyses being included. The bulk of t report deals with the mineral deposits, of which gold is by far t most important, although asbestos is also mined in the area and little copper was produced at one time. The auriferous deposits a classified as (*a*) quartz reefs, which make up 83 % of the producti ore-bodies; (*b*) stockworks, about 14 %; (*c*) siliceous replacements calcareous rocks; and (*d*) eluvial deposits. The history and princip geological features of some ninety gold mines are given in brief. T Fred mine, which is by far the most important producer, yield 277,841 oz. of gold and 21,137 oz. of silver between 1912 and 193

S. J. S.

Aubel (René van). *Sur la zone aurifère de l'Urega oriental (Ki Congo belge)*. Compt. Rend. Acad. Sci. Paris, 1933, vol. 19 pp. 1732–1734.

The gold occurs in quartz veins which penetrate schists of t metamorphic series of the lower stage of the Muva-Ankole-Urun Kibada system; it is associated with pneumatolytic minerals, tourm line, &c., and with mispickel, pyrite, galena, blende, and graphi and traces of bismuth. The occurrences are connected with intrusio of granite and diorite-diabase, and radiate out from Mt. Kibukira.

C. A. S.

Jaskólski (S.) *Les gisements argento-stannifères de Potosi en Boliv —Złoża srebrowo-cynowe Potosi w Boliwji*. Arch. Min. To Nauk. (Arch. Min. Soc. Sci.) Warszawa, 1933, vol. 9, pp. 46– (French), pp. 85–92 (Polish summary), 4 pls.

Description of a collection of rocks and ores with discussion their genesis. [Cf. M.A. **5**–165–167.]

L. J. S.

Deans (T.). *The spherulitic ironstones of west Yorkshire*. Geol. Ma 1934, vol. 71, pp. 49–65, 1 pl.

Spherulitic ironstones occur at the base of, or immediately belo many beds of clay in the Upper Carboniferous. The commonest ty is bedded or nodular sphaerosiderite. The microscopic charact and chemical composition are described, and the origin of the ferr carbonate and of the spherulitic structures is discussed. Ma

erulites show concentric zones which can be accentuated by stain- with hydrogen peroxide by A. F. Hallimond's method (Mem. l. Surv. Special Reports Min. Res. Gt. Brit., 1925, vol. 29, p. 39). es appear to consist of carbonates of slightly different composi- . Analysis of spherulites from Snail Green, Rombalds Moor, wed $FeCO_3$, $MgCO_3$, and $CaCO_3$ to be present in approximately proportions 88 : 8 : 4. The ferrous carbonate is thought to have n precipitated in colloidal form from which it ultimately crystal- d as spherulitic growths. Chamosite, hitherto thought to be ent from the clay-ironstones of the Coal Measures, is found in many he spherulitic ironstones, nodules from Cottingley Beck contain- 70 % of this mineral. Partial replacement by pyrite is described appears to proceed radially from the centre. Weathering alters spherulites partially or completely to limonite. W. C. S.

ND (J. P.). *Relations entre la structure originelle de la phase dispersée des sols originels et la transformation cristalline et métasomatique des sédiments.* Compt. Rend. Acad. Sci. Paris, 1934, vol. 199, pp. 155–157, 3 figs.

he author applies his views regarding the formation of the iron of the Briey basin (Lorraine) to explain the deposition there of etite and haematite, showing that the amount of calcium car- ate, degree of oxidation of iron, and formation of ooliths all ease with distance from the source of the ferruginous waters. percentages of CaO, FeO, and Fe_2O_3 at 100, 250, and 400 m. such source are respectively 2·96, 30·46, 45·00; 3·78, 16·50, 7; and 9·30, 0·91, 58·57. At 100 m. the iron was mainly in the of magnetite, with practically no ooliths; at 250 m. the deposit partially oolitic and the iron partially as haematite; at 400 m. ost entirely oolitic with the iron almost wholly in the form of natite. C. A. S.

THOUSE (W. H.). *The source of vanadium, molybdenum, tungsten, and chromium in oxidized lead deposits.* Amer. Min., 1934, vol. 19, pp. 209–220.

USSEN (Gerard E.). *Spectroscopic analysis of certain galenas, sphalerites, and pyrites.* Ibid., pp. 221–224.

olorimetric and spectroscopic tests made on large single crystals alena, blende, and pyrite from various localities showed in many s the presence of small amounts (0·001–0·01 %) of V, Mo, W, Cr. suggested that the relatively small amounts of these elements

present in certain oxidized ores have been derived mainly from the primary vein minerals, though some may also have been derived from the igneous and sedimentary rocks surrounding the deposits.

L. J. S.

Skerl (A. C.). *Vanadium at the Rhodesia Broken Hill.* Mining Mag. London, 1934, vol. 50, pp. 280–283, 2 figs.

Spectroscopic examination of three samples of sulphide ore containing galena, blende, and pyrite, from Broken Hill, Northern Rhodesia, proved the absence of vanadium. It is therefore suggested that the vanadium present as descloizite and vanadinite in the gossans was derived from the surrounding sedimentary rocks.

L. J. S.

Lebedeff (V.) & Choubert (G.). *Nouvelles observations sur les minéraux du bassin du Niari (A. É. F.).* Compt. Rend. Acad. Sci. Paris, 1934, vol. 198, pp. 484–486.

Deposits of compact or crystalline hemimorphite with smithsonite occur in almost vertically inclined beds of limestone at Mt. Fouati on the right bank of the Lutété, a tributary of the Niari. These minerals are accompanied by willemite, galena, cerussite, chalcosine, malachite, dioptase, and other Zn, Pb, and Cu minerals. There also occur well-developed crystals (orthorhombic octahedra) of descloizite, usually growing in vanadinite, which latter is often covered with a thin crust of pyromorphite concealing its true colour; of phosgenite and wulfenite. The earth or rock surrounding these deposits is largely impregnated with vanadates.

C. A. S.

Charonnat (Raymond) & Roche (*Mlle* Simone). *Le fluor des eaux minérales françaises.* Compt. Rend. Acad. Sci. Paris, 1934, vol. 199, pp. 1325–1328.

Using de Boer's colorimetric method, the fluorine content of 150 French mineral waters has been determined, the results differing greatly from previous determinations (cf. Gautier and Clausmann, Compt. Rend. 1914, **158**, 1389). The highest content (15·5 mg. per litre) occurs in the hottest Plombières waters. Those of Vichy contain 5–8·7 mg. per litre. Cold waters of surface origin contain little. The hypothesis of fumarole origin of the fluorine is not supported.

C. A. S.

(Takeo), Watanabe (Takeo), & Nakamoto (Akira). *On the sulphur deposits associated with iron sulphide ore, found in the Quaternary formation of Japan.* Japanese Journ. Geol. Geogr., 1934, vol. 11, pp. 287–324, 2 pls., 43 text-figs.

e deposits in the two largest sulphur mines in Japan, the Matsuo in prov. Rikuchû and the Horobets mine in prov. Iburi, were d in sulphurous boiling lakes in explosion craters. They consist ls of grey compact sulphur and of black iron sulphide ore, with later veins of pure sulphur. The sulphide ore (sp. gr. 3·5–4) sts of minute globules of iron sulphide, mainly marcasite and pyrite, with grains of sulphur, baryte, and opal. The country- are opalized and alunitized. Similar deposits are now being d in hot springs and solfataras in these districts. L. J. S.

idge (F. C.). *The andalusite sands of the western Transvaal.* Bull. Geol. Survey South Africa, 1934, no. 2, 16 pp.

ds containing andalusite occur rather abundantly in parts of erust and Marico districts of the Transvaal. An attempt was to extract pure andalusite from these sands, with the idea tting it to use as a refractory material. One sample, after nation with bromoform and extraction of magnetic grains with ctro-magnet, yielded a concentrate amounting to 65 % of the e, which on analysis showed over 90 % of Al_2SiO_5. The mineral s as perfectly fresh crystalline fragments; associated minerals uartz, chert, iron and manganese oxides, and scraps of quartzite, one, and altered shale. The concentrate is considered suitable dustrial use. S. J. S.

cke (Leopold) & McClure (Leslie). *Variations in the quality of amosite asbestos at Penge, Transvaal.* Trans. Geol. Soc. South frica, 1934, vol. 36 (for 1933), pp. 29–39, 3 figs.

geology of the South African asbestos occurrences has been described by Hall [M.A. **2**–457]. The rocks in which amosite at Penge are banded ironstones, quartzites, shales, and thin f carbonate rocks consisting of ankerite with some anthophyl- d grunerite. The perfectly fresh fibre is ash-grey, flexible, and . Weathering changes it to soft white and brown varieties, oss of elasticity and reduction of tensile strength. The corre- ing chemical changes are oxidation of iron, partial loss of all including iron, and some loss of water. Igneous intrusions roduced a different type of alteration, the fibre becoming first

brittle and then stony. There is no difference in the optical properti of normal and brittle amosite, but the stony variety has been bre ciated and injected with veinlets of quartz. It is concluded tentative that brittleness is related to the presence of igneous intrusions.

S. J. S.

Hancox (E. G.). *Witherite and barytes.* Mining Mag. London, 193 vol. 51, pp. 76–79, 2 figs.

In the veins in Carboniferous rocks of the north of England bary was probably deposited from hydrothermal solutions. In some vei it was later altered to witherite by the action of solutions probab of potassium carbonate. Sulphide minerals were deposited duri both these stages. Still later were a few minor alterations of witheri to baryte by the action of sulphate solutions. L. J. S.

Coulson (A. L.). *Asbestos in the ceded districts of the Madras Pre dency : with notes on its occurrence in other parts of India.* Mer Geol. Surv. India, 1934, vol. 64, pt. 2, pp. i–vii, 143–266, i–x 5 pls., 6 text-figs.

Small deposits of chrysotile-asbestos occur in serpentinized lim stone in contact with dolerite sills in the Cuddapah district.

L. J. S.

Bhola (K. L.). *A short note on the beryl deposits of Ajmer-Merwa* Trans. Mining Geol. Inst. India, 1934, vol. 29, pp. 127–14 2 figs.

Beryl is obtained as a by-product in mica mining in pegmatit but usually only in small amount. Larger crystals (up to 15 to are found at Bisundni. L. J. S.

Radioactivity.

Hecht (Friedrich). *Quantitative methods of micro-analysis with spec reference to the Gordonia uraninite.* Amer. Journ. Sci., 193 ser. 5, vol. 27, pp. 321–342, 6 figs.

Holmes (Arthur). *The Gordonia uraninite and the upper pre-Cambri rocks of Southern Africa.* Ibid., pp. 343–353.

Details are given of the apparatus and methods of micro-analys Analyses of two samples of somewhat altered uraninite from Gordo gave for Pb : (U + 0·36 Th) 0·154 and 0·173. The more reliab value 0·131 of E. D. Mountain [M.A. **4**–475] is used in a discussi of the geological age of the rocks. L. J. S.

E (W. G.) & LANE (A. C.). *Correlations by radioactive minerals in the metamorphic rocks of southern New England.* Amer. Journ. Sci., 1934, ser. 5, vol. 28, pp. 127–138, 5 figs.

icro-chemical analyses of uraninite from pegmatite in Strickland rry, Portland, Connecticut, were made by F. Hecht on different cals and on the interior and exterior portions of crystals. The J ratios indicate an age of about 280–290 million years, and the natite dikes were injected probably during late Devonian times.

L. J. S.

E (Alfred C.). *Five fold check of uranite* [i.e. uraninite] *age?* Amer. Min., 1934, vol. 19, pp. 1–13, 2 figs.

stimates of the age of uraninite from Wilberforce, Ontario, are e by the following methods: (1) Disintegration of uranium (U_{Ra}) adium. (2) Thorium to lead (Pb_{208}). (3) Uranium (U_{Ac}) to ium and to lead (Pb_{207}). (4) Amount of oxygen. (5) Amount lium. (6) Proportion of isotopes in lead. (7) Specific gravity. results are variable, but are of the order of a thousand million s.

L. J. S.

HEN (C. Stanfield) & AUBEL (René van). *Sur la composition et l'âge de l'uraninite cristalline du Katanga.* Compt. Rend. Acad. Sci. Paris, 1934, vol. 199, pp. 1133–1135.

mbined chemical and spectrographic examinations of crystalline inite, occurring associated with secondary pitchblende at Kasolo, nga, show, besides U, the presence of Ba, Ca, Pb, Mn, Mo, Si, Sr, of smaller amounts of Al, Sb, As, B, Bi, Cr, Co, Cu, Fe, Mg, Ag, Sn, Ti, V, W, Y, and Zr, and of traces of Ce, In, La, and Th. uraninite appears to be a primary hydrothermal mineral. ysis gave U 76·94 %, Pb 6·64, or a ratio Pb : U = 0·0863, im- g (by A. C. Lane's formula; preceding abstract) an age of $< 10^6$ years, as compared with 600×10^6, the similarly calculated of the secondary pitchblende. C. W. Davis's formula [M.A. 3– gives respectively 683×10^6 and 665×10^6 years. C. A. S.

LS (Roger C.), FAIRCHILD (John G.), & Ross (Clarence S.). *Thorianite from Easton, Pa.* Amer. Journ. Sci., 1933, ser. 5, vol. 26, pp. 45–54.

uraninite-like mineral occurs as grains and small cubes embedded rpentine (sometimes in tremolite and scapolite) in a pre-Cambrian stone intruded by pegmatite near Easton in Pennsylvania.

Analysis, UO_2 4·44, UO_3 33·15, ThO_2 38·47, PbO 5·21, rare-earth 2·49, R_2O_3 1·57, MnO 0·31, MgO 0·53, CaO 0·97, H_2O+ 4·39, insc 7·86 = 99·39, sp. gr. 6·68, shows a slight excess of ThO_2 over U and the mineral is referred to thorianite. The age is 790 millio years. Small grains of a dull brown alteration product, referred t gummite, gave on partial analysis U_3O_8 42·70, ThO_2 25·06, PbO 3·8 rare-earths 5·10, insol. 5·90. Yellow coatings on crevices in serpen tine are referred to carnotite and autunite. The list of associate minerals includes brown and sky-blue zircon, the former strongl radioactive. L. J. S.

Piggot (Charles Snowden). *The isotopic composition of the leads o Great Bear Lake.* Journ. Geol. Chicago, 1934, vol. 42, pp. 641 645.

Lead isolated from pitchblende and from galena occurring in th pitchblende veins shows a preponderance of the isotope 206, whil lead from galena in neighbouring veins is ordinary lead of isotop 208 contaminated with some radio-derived lead. Two kinds o galena are thus suggested. L. J. S.

Rößner (Hilde). *Über den Radiumgehalt der Gesteine des Gleinalpen kerns.* Min. Petr. Mitt. (Tschermak), 1933, vol. 44, pp. 495 504, 2 figs.

Diorite, granite, &c., from Gleinalpe, Styria, with SiO_2 60·01— 75·36 % contained $1·63—2·45 \times 10^{-12}$ gram Ra per gram of rock, th amount increasing with the acidity of the rock and also with th percentage of alkalis, especially potassium. An exception to this rul was a tourmaline-pegmatite with SiO_2 72·10 % and Ra $2·80 \times 10^{-12}$ These amounts are less than those given by other observers fo similar rocks from other localities. Results obtained by decom posing the rocks with carbonate fusion or with HF are in agreement L. J. S.

Rothé (E.) & Stoeckel (F.). *Sur la radioactivité des couches géologique de la vallée du Rhin.* Compt. Rend. Acad. Sci. Paris, 1934 vol. 199, pp. 1330–1332.

The radioactivity of twenty-four samples of rocks (Tertiary lime stones and marls) from depths of 100–1279 m. in Alsace has beer determined, being equivalent to a content of $0·24 - 1·86 \times 10^{-12}$ g. Ra

TABLE I. *Reactions of the Elements.*

Reagent	Na	K	Cu	Ag	Au	Mg	Ca	Sr	Ba	Zn	Cd	Hg	B	Al	Tl	Si	Ti	Zr	Sn	Pb	P	V	As	Sb	Bi	SO_4''	Cr	Mo	W	U	Mn	F	Cl
Zinc uranyl acetate	**Y**	–	–	W	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	W	W	–	–	–	–	–	–	–	–	–
Sodium cobaltinitrite	–	**Y**	–	ppt.	–	–	–	–	ppt.	–	–	–	–	–	ppt.	–	–	ppt.	–	ppt.	–	–	–	–	–	–	–	–	–	–	–	–	–
Ammon. mercury thiocyanate + $ZnSO_4$	–	–	**V**	Y	R	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Potassium chromate + acetic acid ...	–	–	–	**R**	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Stannous chloride	–	–	–	–	**Pr**	–	–	–	–	–	–	Bk	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Bl	slight	–	–	–	–
Titan yellow	–	–	Pr	Br	–	**Pk**	–	–	–	Br	R	Y	–	–	R	–	–	–	–	Y	–	–	–	–	–	–	G	–	–	–	Br	–	–
Dihydroxy tartaric osazone	–	–	–	–	–	–	**W** ppt.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Sodium rhodizonate	–	–	–	–	–	–	–	**Br**	**Br**	–	–	–	–	–	Pr	–	–	–	–	Br	–	–	–	–	–	–	–	–	–	–	–	–	–
Ammon. mercury thiocyanate + $CuSO_4$	–	–	–	Y	R	–	–	–	–	**V**	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Diphenyl carbazide thiocyanate + AmOH	–	–	Bl	–	Br	–	–	–	–	–	**V**	V	–	V	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Dimethyl-amino-benzal rhodanine ...	–	–	R	V	V	–	–	–	–	–	–	**V**	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Turmuric	–	–	–	–	Br	–	–	–	–	–	–	–	**G**	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Alizarine S	–	–	–	–	–	Pk	Pk	Pk	Pk	–	–	–	–	**Pk**	–	–	–	R	–	R	–	Or	Br	–	Br	–	Br	Pk	Or	Pr	Br	–	–
Potassium iodide + $Na_2S_2O_3$ ...	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**Y**	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Ammonium molybdate + benzidine ...	–	–	–	–	Bl	–	–	–	–	–	–	–	–	–	–	**Bl**	–	–	–	–	**Bl**	–	Bl	Bl	–	–	–	–	–	–	–	–	–
Hydrogen peroxide	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**Y**	–	–	–	–	Y	–	–	–	–	Y	Y	–	–	–	–	–
Alizarine + HCl	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Y	–	–	**V**	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Phosphomolybdic acid	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**Bl**	–	–	–	–	**Bl**	–	–	–	–	–	–	–	–	–
Dithizon	–	–	Br	R	Y	–	–	–	–	Pk	R	Or	–	–	Pk	–	Pk	–	Pk	**Pk**	–	–	Bl	Pr	**R**	–	–	–	Y	–	Pr	–	–
Aniline	–	–	Y	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**G**	–	–	–	–	Bl	–	–	–	–	–	–
Gutzeit reaction	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**Bk**	–	–	–	–	–	–	–	–	–	–
Thiourea	–	–	–	W	–	–	–	–	–	–	–	W	–	–	W	–	–	–	–	W	–	Bl	–	–	**Y**	–	G	–	–	–	–	–	–
Mercuric nitrate	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	G	–	–	–	**Y**	V	V	–	–	–	–	–
Diphenyl carbazide	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
KCNS + $SnCl_2$	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	G	–	–	–	–	V	V	–	–	–	–	–
Potassium ferrocyanide	–	–	Br	–	G	–	–	–	–	–	–	Bl	–	–	Y	–	Br	G	Bl	–	–	–	–	Bl	Bl	–	–	**R**	**Bl**	–	–	–	–	–
$Am_2S_2O_6 + H_3PO_4 + AgNO_3$	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**Br**	–	–	–
$SiO_2 + H_2SO_4$, Am_2MoO_4, &c.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**Pr**	–	–
$K_2Cr_2O_7 + H_2SO_4$, &c.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**Bl**	–
Starch + KNO_2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**V**
Potassium thiocyanate + HCl	–	–	–	–	R	–	–	–	–	–	–	–	–	–	W	–	–	Pk	–	–	–	Gr	–	–	–	–	–	Y	–	–	–	–	–
β-nitroso-α-naphthol	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	R	–	–	–	Br	–	–	–	–	–	–	–	–	–	–	–
Dimethylglyoxime	–	–	–	Br	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Y	Br	–	–

Bk = Black. **Bl** = Blue. **Br** = Brown. **G** = Green. **Or** = Orange. **Pk** = Pink. **Pr** = Purple. **R** = Red. **V** = Violet. **W** = White. **Y** = Yellow.

volite from the Vosges showed radioactivity equivalent to 10^{-12} g. Ra. C. A. S.

OHR (Paul). *Radioaktive Höfe in Quarz, Yttrofluorit und Zinnstein und neue Feststellungen über das atomare Bremsvermögen der Elemente.* Neues Jahrb. Min., Abt. A, 1933, Beil.-Bd. 67, p. 63–68, 1 pl.

ng to the complex composition of the host minerals (biotite, rite, &c.) in which pleochroic haloes have been previously red, it has not been possible to deduce the atomic stopping . The following ranges of haloes around particles of uranium ils in host minerals of simple composition give some indication stopping power.

	Quartz.	Fluorite.	Yttrofluorite.	Cassiterite.
RaC′ ...	38·7	34·5	33·9	22·2 μ
RaA ...	25·8	23·5	22·9	14·7

L. J. S.

RSON (G. H.). *A quantitative study of pleochroic haloes.—I.* roc. Roy. Soc. London, Ser. A, 1934, vol. 145, pp. 563–581, pls., 5 text-figs.

—— *II.* Ibid., 1934, vol. 145, pp. 582–591, 1 pl., 1 text-fig. cometric records were obtained of pleochroic haloes in specimens ite from various localities, a special study being made of brown ens from Murray Bay, Quebec, and Egansville, Renfrew Co., o, both of pre-Cambrian age, and of a green biotite from Mount e, Maine, U.S.A., the last probably of Devonian age. A microprojects an enlarged image of the halo upon a slit and light through the slit falls on a photoelectric cell. A mechanism ving the image of the halo slowly across the slit is geared to a g drum bearing photographic paper upon which is recorded tically the variations in blackening across a halo diameter. ore accurate data obtained by this halo photometer fully conevious work and show better agreement with the α-ray ranges uranium and actinium families. Artificial blackening of the ens by α-ray bombardment suggests that halo discoloration is obably entirely to ionization and leads to a theory of the on of the haloes in general agreement with the photometer excepting for over-exposed haloes. There is no evidence of ange in the ranges of α-particles in the course of geological

F. A. B.

Henderson (G. H.). *A new method of determining the age of certa minerals.* Proc. Roy. Soc. London, Ser. A, 1934, vol. 14 pp. 591–598, 1 fig.

The measurements of the actinium series in pleochroic haloes the biotite specimens previously studied lead to a new method finding the ages of halo-bearing minerals. The ages deduced are 80 750, and 400 million years for biotite from Renfrew Co., Murray Ba and Mt. Apatite respectively (see previous abstract). F. A. B.

X-rays and Crystal-structure.

Goldschmidt (Victor) [1853–1933]. *Über Strahlenpunktsysteme u Flächenpunktsystem.* Beitr. Kryst. Min., 1934, vol. 3, pp. 14 221, 3 pls.

A fuller account of a preliminary paper [M.A. **5**–461] giving quar and topaz as examples. Tables are given for fixing the positions the spots. L. J. S.

Berg (W. F.). *Laue diagrams of deformed crystals.* Zeits. Kris 1934, vol. 89, pp. 587–593, 5 figs.

The effect of deformation of a crystal on Laue diagrams obtain by transmitted and reflected rays is considered. The theory illustrated by Laue diagrams of rock-salt in which the settings of t crystal differ by 2°. H. H.

Seljakow (N. J.) & Sows (E. I.). *Ein graphisches Indizierungsv fahren von Drehkristallaufnahmen.* Zeits. Krist., 1934, vol. 8 pp. 601–606, 3 figs.

The authors give a graphical method of finding indices from o servations made by X-ray rotation photographs. H. H.

Hulubei (Horia) & Cauchois (*Mlle* Yvette). *Nouvelle technique d la spectrographie cristalline des rayons γ.* Compt. Rend. Aca Sci. Paris, 1934, vol. 199, pp. 857–859, 1 fig.

An apparatus is described, depending essentially on focusing wi a curved crystal so arranged that the spectrum can be analys photographically or by a Geiger counter. With X-ray source a an exposure of 15 min. MoKβ_4 is easily measurable, with one several hours all the forbidden Kβ lines including β_8 and β_9 are With 150–250 millicuries of radon as source and 12 hours expos a very complex spectrum extending beyond 350X is obtained.

C. A. S.

ıG (Harold P.). *The X-ray study of red monoclinic selenium. Proof of the existence of two red monoclinic varieties of selenium.* Zeits. Krist., 1934, vol. 88, pp. 128–135, 2 figs.

he α form of red selenium probably has the space-group C_{2h}^2. unit cell contains 32 atoms of Se and has a 8·992, b 8·973, 52 Å., β 88° 26′. The β form probably has the space-group C_{2h}^5. unit cell probably contains 32 atoms and has a 12·74, b 8·04, 5 Å., β 86° 56′. H. H.

ıT (C. D.) & PETERSON (A. W.). *The crystal structure of $AuAl_2$.* Zeits. Krist., 1934, vol. 88, pp. 93–94.

ıe alloy $AuAl_2$ has probably the CaF_2 structure with a 6·00 Å. H. H.

ıN (E. A.) & PICKUP (Llewelyn). *Parameter values of copper-nickel alloys.* Zeits. Krist., 1934, vol. 88, pp. 116–121, 2 figs.

ıarameter measurements with a precision X-ray camera on Cu-Ni rs gave 8·94 and 8·89 for the densities of pure copper and nickel, showed that the alloy of maximum density (8·95) contained t 34 atomic per cent. of nickel. H. H.

ıRD (L.) & KLOSTER (Arne). *Gold-Kupferlegierungen, insbesondere bei hohen Temperaturen.* Zeits. Krist., 1934, vol. 89, pp. 560–574, 9 figs.

ıe edge of the cubic unit cell for a copper-gold alloy was ıured at room-temperature and at a temperature of 475° C. for ıus atomic ratios of the two metals. The length of the cell's is rather greater than that deduced from the values for pure ıer and gold by the additive law. H. H.

ıDER (Arne). *Kristallstruktur der Thallium-Wismut-Legierungen.* Zeits. Krist., 1934, vol. 89, pp. 89–92.

loys of thallium and bismuth stable for an atom-percentage of ıum between 73 and 96 have the cubic structure of β-thallium, he modification of thallium stable above 227° C. Alloys stable ıtom-percentages of thallium between 34 and 36 have the ture of α-thallium. H. H.

ıMETEW (E.). *Röntgenographische Bestimmung der $FeAl_3$-Struktur.* Zeits. Krist., 1934, vol. 89, pp. 575–586, 4 figs.

ystals of $FeAl_3$ obtained from an iron-aluminium alloy have the -group V_h^{23}. The unit cell contains a hundred molecules of $_3$ and has a 47·43, b 15·46, c 8·08 Å. H. H.

Laves (Fritz). *Über eine Mangan-Silicium-Legierung vom Wolfram-Typ (A2-Typ).* Zeits. Krist., 1934, vol. 89, pp. 189–191.

A cubic alloy of manganese and silicon exists with the composition Mn_3Si. Its unit cell contains two molecules and has an edge of 2·85 Å. H. H.

Hägg (Gunnar). *Pulverphotogramme eines neuen Eisencarbides.* Zeits. Krist., 1934, vol. 89, pp. 92–94.

The position of the lines is given in a powder X-ray photograph of a new iron carbide richer in carbon than Fe_3C. H. H.

West (C. D.). *The crystal structures of some alkali hydrosulfides and monosulfides.* Zeits. Krist., 1934, vol. 88, pp. 97–115, 3 figs.

CsSH has the cubic CsCl structure with a 4·29 Å. NH_4SH has the space-group D_{4h}^7. The unit cell contains two molecules and has a 6·01, c 4·01 Å. NaSH, KSH, and RbSH have a trigonal structure with space-group D_{3d}^5. The unit cell is given by a 3·99, α 68° 5′; a 4·37, α 68° 51′; a 4·53, α 69° 20′, respectively. They have also at high temperatures a cubic NaCl structure for which a is 6·05, 6·60, 6·93, respectively. K_2S has the cubic CaF_2 structure with four molecules in a unit cell whose edge is 7·35 Å. H. H.

Offner (Franklin). *A redetermination of the parameter for hauerite, MnS_2.* Zeits. Krist., 1934, vol. 89, pp. 182–184, 3 figs.

Taking the space-group of hauerite as T_h^6 and the edge of the unit cell as 6·096 Å, the positions of the Mn and S atoms are determined. H. H.

Tokody (L.). *Berichtigung zu meiner Mitteilung „Über Hessit.“* Zeits. Krist., 1934, vol. 89, p. 416.

The unit cell given for hessite in an earlier paper [M.A. **5**–175] should have been a 6·57, b 6·14, c 6·10 Å. The corresponding values for the axial ratios are $a : b : c = 1{\cdot}070 : 1 : 0{\cdot}993$, $\beta = 61° 15'$. H. H.

Harker (David). *The crystal structure of the mineral tetradymite, Bi_2Te_2S.* Zeits. Krist., 1934, vol. 89, pp. 175–181, 2 figs.

Tetradymite has a rhombohedral unit cell with a 10·31 Å., α 24° 10′. The atomic positions are S at 000; 2Bi at $\pm(uuu)$; 2Te at $\pm(vvv)$, with $u = 0{\cdot}392$, $v = 0{\cdot}788$. H. H.

OCKWAY (L. O.). *The crystal structure of stannite, Cu_2FeSnS_4.* Zeits. Krist., 1934, vol. 89, pp. 434–441, 2 figs.

Stannite from Oruro, Bolivia, has the space-group D_{2d}^{11}. The unit l contains two molecules of Cu_2FeSnS_4 and has a 5·46, c 10·725 Å. $c = 1 : 0{\cdot}982$). H. H.

ULING (Linus) & NEUMAN (E. W.). *The crystal structure of binnite, $(Cu,Fe)_{12}As_4S_{13}$, and the chemical composition and structure of minerals of the tetrahedrite group.* Zeits. Krist., 1934, vol. 88, pp. 54–62, 1 fig.

Binnite has the space-group T_d^3. The unit cell contains two molecules of $(Cu,Fe)_{12}As_4S_{13}$ and has a 10·19 Å. H. H.

LING (Linus) & WEINBAUM (Sidney). *The crystal structure of enargite, Cu_3AsS_4.* Zeits. Krist., 1934, vol. 88, pp. 48–53, 1 fig.

The structure of enargite is similar to that of wurtzite. The ce-group is C_{2v}^7. The unit cell contains two molecules of Cu_3AsS_4 l has a 6·46, b 7·43, c 6·18 Å. H. H.

ST (C. D.). *The pseudo symmetry of enargite.* Amer. Min., 1934, vol. 19, pp. 279–280.

Powder photographs of enargite give a hexagonal cell with dimen- a 3·71, c 6·16 Å., near to those of wurtzite and containing u_3AsS_4). A Laue photograph through the basal plane gives a tern of the symmetry D_{6h} on which is superimposed a weak pattern symmetry V_h. The mineral thus has a close-packed pseudo- agonal structure, and powder photographs alone are misleading. M.A. **5**–467.] L. J. S.

ST (C. D.). *On the high temperature modification of CsCl.* Zeits. Krist., 1934, vol. 88, p. 94.

t 500° C. caesium chloride has the NaCl structure, the cubic unit having an edge of 7·08 Å. H. H.

KKEN (H.) & SCHOLTEN (W.). *Die Kristallstruktur des Quecksilberchlorids $HgCl_2$.* Zeits. Krist., 1934, vol. 89, pp. 448–455, 5 figs.

he space-group of mercuric chloride is V_h^{16}. The unit cell con- s four molecules of $HgCl_2$ and has a 5·963, b 12·735, c 4·325 Å. positions of the atoms are determined by the authors in this sion of earlier work. H. H.

Grime (H.) & Santos (J. A.). *The structure and colour of anhydrous cobalt chloride, $CoCl_2$, at room and very low temperatures.* Zeits. Krist., 1934, vol. 88, pp. 136–141, 1 fig.

Anhydrous cobalt chloride has a rhombohedral unit cell containing one molecule of $CoCl_2$ for which a 6·16 Å., α 33° 26′. A discussion is given of the relation of structure to colour in cobalt compounds.

H. H.

Ketelaar (J. A. A.). *Die Kristallstruktur des Nickelbromids und -jodids.* Zeits. Krist., 1934, vol. 88, pp. 26–34.

Nickel bromide and iodide have a structure of the $CdCl_2$ type with a rhombohedral unit cell containing one molecule of $NiBr_2$ or NiI_2. It has a 6·46, α 16° 40′ for the bromide, and a 6·92 Å., α 16° 20′ for the iodide. H. H.

Bruni (G.) & Ferrari (A.). *Isomorfismo fra composti di elementi a valenza diversa.* Zeits. Krist., 1934, vol. 89, pp. 499–504, 4 figs.

The practically identical structures of $CdCl_2$ and $MgCl_2$ can be derived from that of LiCl by supposing the places of the Cl atoms unaltered but the positions of half the Li atoms left empty.

H. H.

Ketelaar (J. A. A.). *Die Kristallstruktur der Hochtemperaturmodifikationen von Ag_2HgI_4 und Cu_2HgI_4.* Zeits. Krist., 1934, vol. 87, pp. 436–445.

When heated above 50° C., yellow silver mercury iodide changes into a red modification; and when heated above 70° C., red copper mercury iodide becomes brown. The high temperature varieties are both cubic with space-groups T_d^3 and T^3 respectively. The unit cell contains one molecule of Ag_2HgI_4 or Cu_2HgI_4 and has a 6·383 Å. for the silver and a 6·103 Å. for the copper salt. H. H.

Andress (K. R.) & Carpenter (C.). *Krystallhydrate. II. Die Struktur von Chromchlorid- und Aluminiumchloridhexahydrat.* Zeits. Krist., 1934, vol. 87, pp. 446–463, 8 figs.

The space-group of chromium chloride hexahydrate and aluminium chloride hexahydrate is D_{3d}^6 and the rhombohedral unit cell contains two molecules of $Cr(H_2O)_6Cl_3$ or $Al(H_2O)_6Cl_3$. Its dimensions are a 7·9 Å., α 97°, and a 7·8 Å., α 97°, respectively. H. H.

ROBAK (L.). *Quantitative spectrometric studies of ammonium and of potassium cupric chloride dihydrate* $(NH_4)_2CuCl_4.2H_2O$ *and* $K_2CuCl_4.2H_2O$. Zeits. Krist., 1934, vol. 88, pp. 35–47, 3 figs.

Both salts have the space-group D_{4h}^{14} and the unit cell of each contains two molecules. The electron densities are determined by a Fourier analysis. H. H.

CHMEL (M.) & NESPITAL (W.). *Kristallographische und röntgenographische Untersuchungen am Kaliumbleichlorid. (Ein Beitrag zur Mischkristallbildung im System* KCl–$PbCl_2$.) Zeits. Krist., 1934, vol. 88, pp. 345–355, 2 figs.

The optical behaviour points to potassium lead chloride being clinic. But crystallographic and X-ray measurements give a udo-monoclinic structure with a unit cell containing four molecules of $(KPbCl_3)_3.H_2O$ and having a 14·3, b 9·05, c 14·5 Å., β 67°. e space-group is probably C_i^1. The axial ratios are $a:b:c = 59:1:1{\cdot}61$, $\beta = 67°$. H. H.

AEY (Robert B.) & WYCKOFF (Ralph W. G.). *The crystal structure of dimethyl ammonium chlorostannate.* Zeits. Krist., 1934, vol. 89, pp. 469–476, 4 figs.

The space-group of dimethyl ammonium chlorostannate is C_2^7. e unit cell contains two molecules of $[(CH_3)_2NH_2]_2SnCl_6$ and has ·26, b 7·38, c 14·28 Å. H. H.

CKINSON (B. N.). *The crystal structure of tetramminopalladous chloride* $Pd(NH_3)_4Cl_2.H_2O$. Zeits. Krist., 1934, vol. 88, pp. 281–297, 3 figs.

The space-group of tetramminopalladous chloride is probably D_{4h}^5. e unit cell contains two molecules of $Pd(NH_3)_4Cl_2.H_2O$ and has 0·302, c 4·34 Å. H. H.

HULZE (Gustav E. R.). *Kristallform und Raumgitter von* ZrF_4 *und* HfF_4. Zeits. Krist., 1934, vol. 89, pp. 477–480.

Monoclinic zirconium and hafnium fluorides have axial ratios $b:c = 0{\cdot}9585:1:0{\cdot}7732$, $\beta = 85°\ 30'$, and $a:b:c = 0{\cdot}9623:1:$ 7744, $\beta = 85°\ 31'$, respectively. Their space-group is C_{2h}^6. Their it cells contain twelve molecules of ZrF_4 or HfF_4. Their edges e a 9·46, b 9·87, c 7·64 Å., and a 9·45, b 9·84, c 7·62 Å., respecely. H. H.

Hultgren (Ralph). *The crystal structure of ammonium beryllium fluoride, $(NH_4)_2BeF_4$.* Zeits. Krist., 1934, vol. 88, pp. 233–237, 1 fig.

Ammonium beryllium fluoride forms orthorhombic crystals with axial ratios $a:b:c = 0.5688:1:0.7367$. Its space-group is V_h^{16}. The unit cell contains four molecules of $(NH_4)_2BeF_4$ and has a 5·8, b 10·2, c 7·5 Å. The salts $(NH_4)_2BeF_4$ and K_2BeF_4 are isomorphous with each other, but not with Na_2BeF_4. H. H.

Goßner (B.) & Kraus (O.). *Das Kristallgitter von Ammoniumhexafluorosilikat $(NH_4)_2SiF_6$.* Zeits. Krist., 1934, vol. 88, pp. 223–225.

Ammonium hexafluosilicate [cryptohalite] has a cubic and a trigonal modification. The space-group of the latter is D_{3d}^3. The unit cell, taken as a hexagonal prism, contains one molecule of $(NH_4)_2SiF_6$ and has a 5·76, b 4·77 Å. H. H.

Corey (Robert B.). *The crystal structure of tetramethyl ammonium fluosilicate.* Zeits. Krist., 1934, vol. 89, pp. 10–17, 4 figs.

Tetramethyl ammonium fluosilicate has the space-group C_{4h}^5. The unit cell contains two molecules of $[(CH_3)_4N]_2SiF_6$ and has a 7·88, c 11·19 Å. H. H.

Brasseur (H.), Rassenfosse (A. de), & Piérard (J.). *Recherches cristallographiques sur les cyanures doubles. (4e communication.) Étude cristallographique du nickelocyanure de baryum $BaNi(CN)_4.4H_2O$.* Zeits. Krist., 1934, vol. 88, pp. 210–222, 5 figs.

The space-group of barium nickel cyanide is C_{2h}^6. The unit cell contains four molecules of $BaNi(CN)_4.4H_2O$ and has a 11·71, b 13·48, c 6·63 Å., β 85° 10′. H. H.

Bouchal (F.) & Dolejsek (V.). *Sur l'application de la méthode de Valouch, pour mesurer les constantes des réseaux cristallins, à la méthode de précision de Kunzl et Köppel.* Compt. Rend. Acad. Sci. Paris, 1934, vol. 199, pp. 1054–1056.

Valouch's method, exemplifled by application to the $(10\bar{1}1)$ face of quartz, gives a result ($d_\infty = 3336{\cdot}62$ X.U.) of equal accuracy with that of Kunzl and Köppel [cf. M.A. **5**–305]. A recalculation of Siegbahn and Dolejsek's result for the prismatic face of quartz brings it into agreement with that of Berquist, $d = 4244{\cdot}92$ X.U. C. A. S.

HERMAN (J.). *The Madelung constant of cuprite: a correction.* Zeits. Krist., 1934, vol. 87, p. 342.

The Madelung constant of the cuprite structure should be 5·12972, ot 4·75219, as given earlier by O. Emersleben (1923) and by J. ierman (1932). H. H.

RILL (Rudolf). *Die Gitterkonstanten von α-Fe_2O_3.* Zeits. Krist., 1934, vol. 88, pp. 177–178.

The unit cell of ferric oxide was found to be *a* 5·4144 Å., 55° 14·7′ in agreement with the results of S. Katzoff and E. Ott [M.A. **5**–471]. H. H.

ARTH (Tom. F. W.) & POSNJAK (E.). *The crystal structure of ilmenite.* Zeits. Krist., 1934, vol. 88, pp. 265–270, 2 figs.

The space-group of ilmenite is C_{3i}^2 and the structure is similar to iat of corundum. H. H.

(Teiichi). *On the resemblance of tellurite (TeO_2) and brookite (TiO_2).* Journ. Geol. Soc. Tokyo, 1933, vol. 40, pp. 613–616 (Japanese); abstract in Japanese Journ. Geol. Geogr., 1934, vol. 11, abstracts p. 10.

Tellurite from Rendaizi mine, Idu, Japan [M.A. **5**–479], gave 0·50, *b* 11·75, *c* 5·59 Å. (*a* : *b* : *c* = 0·467 : 1 : 0·476), with eight mole- les in the unit cell and space-group V_h^{15}. These values are com- red with those for brookite [M.A. **4**–28, 29]. L. J. S.

ßNER (B.) & KRAUS (O.). *Das Kristallgitter der Tellursäure TeO_6H_6.* Zeits. Krist., 1934, vol. 88, pp. 298–303.

The cubic modification of telluric acid has the space-group O_h^5. ne unit cell contains four molecules of TeO_6H_6 and has *a* 7·83 Å. ne monoclinic modification probably has the space-group C_{2h}^5. The nit cell contains four molecules and has *a* 5·54, *b* 9·30, *c* 9·74 Å., 75° 30′. H. H.

ACHARIASEN (W. H.). *The crystal lattice of boric acid, BO_3H_3.* Zeits. Krist., 1934, vol. 88, pp. 150–161, 1 fig.

Boric acid has a unit cell containing four molecules of H_3BO_3 and aving *a* 7·04, *b* 7·04, *c* 6·56 Å., *α* 92° 30′, *β* 101° 10′, *γ* 120°. H. H.

Colby (M. Y.) & Harper (J. P.). *A note on the density and crystal structure of sodium carbonate monohydrate, $Na_2CO_3.H_2O$.* Zeits. Krist., 1934, vol. 89, p. 191.

The space-group of sodium carbonate is $2D_i$–1. The unit cell contains four molecules of $Na_2CO_3.H_2O$ and has a 10·72, b 6·44, c 5·24 Å. The density is 2·26. H. H.

Ziegler (G. E.). *The crystal structure of lithium sulphate monohydrate, $Li_2SO_4.H_2O$.* Zeits. Krist., 1934, vol. 89, pp. 456–461, 2 figs.

Lithium sulphate with one molecule of water of crystallization has the space-group C_2^2. The unit cell contains two molecules of $Li_2SO_4.H_2O$ and has a 5·43, b 4·83, c 8·14 Å., β 72° 25′. H. H.

Pabst (Adolf). *The crystal structure of sulphohalite.* Zeits. Krist., 1934, vol. 89, pp. 514–517, 1 fig.

The unit cell of the cubic sulphohalite from Searles Lake, California, contains four molecules of $2Na_2SO_4.NaCl.NaF$ and has an edge of 10·08 Å. The positions of the atoms are given. H. H.

Zachariasen (W. H.). *The atomic arrangement in potassium trithionate crystals $K_2S_3O_6$ and the structure of the trithionate radical $(S_3O_6)^{-2}$.* Zeits. Krist., 1934, vol. 89, pp. 529–537, 2 figs.

The space-group of potassium trithionate is V_h^{16}. The unit cell contains four molecules of $K_2S_3O_6$ and has a 9·77, b 13·63, c 5·76 Å. The parameter values of all the atoms were determined. H. H.

Zachariasen (W. H.) & Mooney (R. C. L.). *The atomic arrangement in ammonium and caesium persulphate $(NH_4)_2S_2O_8$ and $Cs_2S_2O_8$, and the structure of the persulphate group.* Zeits. Krist., 1934, vol. 88, pp. 63–81, 3 figs.

The space-group of the caesium and ammonium persulphates is C_{2h}^5 and the unit cell contains two molecules. Its dimensions are a 8·13, b 8·33, c 6·46 Å., β 84° 41′ for $Cs_2S_2O_8$; and a 7·83, b 8·04, c 6·13 Å., 84° 51′ for $(NH_4)_2S_2O_8$. H. H.

West (C. D.). *Crystal structures of some hydrated compounds. I. $LiClO_4.3H_2O$, $LiI.3H_2O$, $Ba(ClO_4)_2.3H_2O$.* Zeits. Krist., 1934, vol. 88, pp. 198–204, 1 fig.

Lithium chlorate has space-group C_{6v}^4. The unit cell contains two molecules of $LiClO_4.3H_2O$ and has a 7·71, c 5·42 Å. Lithium iodide +3aq. has a similar structure, with a 7·45, c 5·45 Å. Barium

ilorate has the space-group C_6^6 or C_{6h}^2. The unit cell contains two olecules of $Ba(ClO_4)_2.3H_2O$ and has a 7·28, c 9·64 Å. The refractive dices of the three salts were obtained. H. H.

REY (Robert B.) & PESTRECOV (K.). *The space group of silver nitrate diammoniate $AgNO_3.2NH_3$.* Zeits. Krist., 1934, vol. 89, p. 528.

The space-group of silver nitrate diammoniate is probably C_{2v}^{10}. ne unit cell contains four molecules of $AgNO_3.2NH_3$ and has edges 3·00, b 10·58, c 6·29 Å. H. H.

o (T.). *The structure of epididymite ($HNaBeSi_3O_8$).* Zeits. Krist., 1934, vol. 88, pp. 142–149, 5 figs.

The space-group of epididymite is V_h^{16}. The unit cell contains ght molecules of $HNaBeSi_3O_8$ and has a 12·63, b 7·32, c 13·58 Å. H. H.

MURCHY (R. C.). *The crystal structure of the chlorite minerals.* Zeits. Krist., 1934, vol. 88, pp. 420–432, 3 figs.

Six varieties of chlorite, when tested by the powder method, were nd to have the same structure with the space-group C_{2h}^6 (possibly). The unit cell contains four molecules of $Al_2Mg_5Si_3O_{10}(OH)_8$ d has dimensions lying between a 5·304 to 5·352, b 9·187 to 9·270, 8·306 to 28·582 Å., with β about 82° 51′. A specimen of amesite d apparently a structure different from that of the other chlorites. H. H.

UNER (John W.). *The crystal structures of talc and pyrophyllite.* Zeits. Krist., 1934, vol. 88, pp. 412–419, 2 figs.

Talc and pyrophyllite have the space-group C_{2h}^6. The unit cell ntains four molecules of $Mg_3Si_4O_{10}(OH)_2$ or $Al_2Si_4O_{10}(OH)_2$ respec-ely. For talc a, b, c (in Å units), and β are 5·26, 9·10, 18·81, °. For pyrophyllite they are 5·14, 8·90, 18·55, 80° 5′. H. H.

SNJAK (E.) & BARTH (Tom. F. W.). *Notes on some structures of the ilmenite type.* Zeits. Krist., 1934, vol. 88, pp. 271–280, 2 figs.

Cadmium titanate formed below 1050°C. crystallizes in a structure y similar to that of $NiTiO_3$, $CoTiO_3$, $MnTiO_3$, $MgTiO_3$, and ilmenite. higher temperatures $CdTiO_3$ changes into a modification with the rovskite structure which does not invert on cooling. H. H.

Mehmel (Martiń). *Feinbauliche Untersuchungen am Borazit.* Zeits. Krist., 1934, vol. 88, pp. 1–25, 8 figs.

α-Boracite has the space-group T_d^5 or T_d^2. The unit cell contains four molecules of $Cl_2Mg_6B_{14}O_{26}$ and has a 12·1 Å. β-Boracite has the space-group C_{2v}^{12} or C_{2v}^{14}. The unit cell contains eight molecules and has a 17·07, b 17·07, c 12·07 Å. H. H.

Clark (George L.) & Werner (Charles O.). *The crystal structure of the silver nitrate-urea addition compound. I. Space group and molecular association.* Zeits. Krist., 1934, vol. 88, pp. 161–172, 5 figs.

The space-group of silver nitrate-urea is probably C_{2h}^2. The unit cell contains eight molecules of $AgNO_3.CO(NH_2)_2$ and has a 10·23, b 16·84, c 6·25 Å., β 77°. H. H.

Zachariasen (W. H.). *The crystal lattice of oxalic acid dihydrate $H_2C_2O_4.2H_2O$ and the structure of the oxalate radical.* Zeits. Krist., 1934, vol. 89, pp. 442–447, 2 figs.

The space-group of oxalic acid dihydrate is C_{2h}^5. The unit cell contains two molecules of $H_2C_2O_4.2H_2O$ and has a 6·12, b 3·61, c 12·03 Å., β 73° 48′. H. H.

Miscellaneous.

Ramdohr (Paul). *Nordenskiöldin in einer Zinnerzlagerstätte.* Neues Jahrb. Min., Abt. A., 1934, Beil.-Bd. 68, pp. 288–295, 2 pls.

An ore pipe in marble near a granite contact at Arandis, South West Africa [M.A. **4**–410], contains near its margin cassiterite, tourmaline, and small colourless plates of the rare mineral nordenskiöldine ($CaSn(BO_3)_2$, previously known only as two small crystals from nepheline-syenite from Norway). This has a perfect basal cleavage (0001) and also ($10\bar{1}1$), ω 1·778, ϵ 1·660. X-ray measurements by H. Ehrenberg gave a 4·85, c 15·92 Å. Usually, however, the mineral is represented by pseudomorphs of cassiterite and calcite, or of stannite. The calcite and cassiterite are often in regular orientation with the nordenskiöldine, and there are also regular overgrowths of chalybite. The mineral was probably formed under very high temperature and pressure. L. J. S.

Eskola (Pentti). *On the chrome minerals of Outokumpu.* Compt. Rend. Soc. Géol. Finlande, 1933, no. 7, pp. 26–44, 1 fig.

Various chromium minerals occurring in different rocks in the neighbourhood of the Outokumpu copper-mine in eastern Finland

e believed to be of hydrothermal origin. Only little chromite is esent in the large body of serpentine-rock. Quartzite carries fuchsite r_2O_3 4·9%) with some chrome-diopside, chrome-tremolite and uvaro- te. Chrome-diopside and chrome-tremolite form a skarn in associa- on with dolomite, and crystals of chromite occur in the dolomite-rock. cotite and kämmererite are found in an anthophyllite-cordierite- ck. Uvarovite and tawmawite with some chromite occasionally cur in the copper ore, and there are remarkable veins composed of ese minerals with pyrrhotine. Uvarovite as large (1·8 cm.) crystals ve analysis I by L. Lokka; n (green) 1·8467, ranging to 1·8516 in her crystals. Tawmawite (chrome-epidote) gave II; optic axial ane $\perp$ (010), $\alpha : c = -24°$, 2V about 50°, negative, α 1·695, γ 1·715; eochroism, α olive-green, β brown, γ emerald-green. Chrome- molite contains Cr_2O_3 1·61 %; sp. gr. 3·00, $\gamma : c = 18°$, β 1·626, - α 0·028.

SiO_2.	Al_2O_3.	Cr_2O_3.	Fe_2O_3.	MnO.	MgO.	CaO.	ign.	Total.	Sp. gr.
35·88	1·13	27·04	2·46	0·03	0·04	33·31	0·18	100·07	3·75
39·26	24·38	6·79	4·18	—	0·53	20·09	4·41	99·64	—

L. J. S.

RR (W. A.). *A barite vein cutting granite of southeastern Missouri.* Amer. Min., 1932, vol. 17, pp. 443–448.

A narrow (4 inch) vein of dark red baryte occurs in a fault plane granite in a quarry near Graniteville, Iron County, Missouri. The er minerals in the vein are pyrite, fluorite, a little galena, and a neral provisionally identified as saponite. Pyrite was the first neral to be deposited, but it continued to be deposited along with baryte and occurs as inclusions in the latter. The vein is believed be of magmatic origin. Its discovery in the granite strengthens view advanced by the author in 1916 that the extensive baryte osits in the dolomites of Washington County, Missouri, are also gmatic.

W. C. S.

RR (W. A.). *The origin of the sand barites of the Lower Permian of Oklahoma.* Amer. Min., 1933, vol. 18, pp. 260–272, 1 fig.

Groups of rough tabular sand-filled baryte crystals in the form of ettes ('sand barites', locally known as 'rock roses') and rounded yte concretions occur in the sandstones of the lower part of the mian (Garber and Wellington formation) in central Oklahoma. baryte acts as a cement to the sand grains, and has been deposited

probably through reaction with some soluble sulphate of chloride waters carrying $BaCl_2$. The source of the barium is believed to be chiefly barium silicates, and partly detrital baryte, and barium adsorbed in colloids. W. C. S.

LINDNER (Joseph). *Über die Störung der maßanalytischen Kohlensäure Bestimmung durch den Kieselsäuregehalt der Baritlaugen.* Zeits. Anal. Chem., 1933, vol. 94, pp. 1–7.

Some of the modifications introduced by E. Dittler and H. Hueber [M.A. **5**–141] into the author's method for estimation of water and CO_2 are adversely criticized. In particular, $N/100$, or even $N/20$ $Ba(OH)_2$ attacks glass much too rapidly, and after storage can no longer be satisfactorily titrated with phenolphthalein. Recently prepared $Ba(OH)_2$ solution, not weaker than $N/10$ and preferably containing 1% $BaCl_2$, must be used if the double titration method is to be adopted. M. H. H.

TAMM (Olof). *Experimentelle Studien über die Verwitterung von Silikatmineralien.* Arkiv Kemi, Min. Geol., 1934, vol. 11, no. 14, 27 pp., 12 figs. [Cf. M.A. **5**–361].

The properties of very fine ($< 1\mu$) powders of silica-glass, orthoclase, muscovite, stilbite, and wollastonite have been studied in some detail. The powders are in general highly hygroscopic, adsorbing considerable amounts of water-vapour from the air. Suspended in water, partial dissociation takes place, and the sols (except that of silica) react alkaline. The muscovite and stilbite sols can be reversibly titrated with acid over a limited range; outside this range decomposition of the particles sets in. Differences in behaviour of orthoclase ground under water and under benzene suggest that in the former case alteration takes place, with production of a material related to muscovite. M. H. H.

VAVRINECZ (Gabriel). *Chemische Zusammensetzung einiger ungarischer Cerussite.* Zeits. Krist., 1934, vol. 89, pp. 521–525.

Analyses are given of cerussite from fifteen Hungarian localities. The mineral consists of $PbCO_3$ replaced by other carbonates to an extent not exceeding 12 %. The commonest elements replacing lead are calcium and magnesium with a little iron. Occasionally zinc and copper also occur. H. H.

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MINERALOGICAL MAGAZINE

CONTENTS OF NO. 148

(March, 1935)

PAGE

Bye-laws and List of Members vii

Proceedings of the Mineralogical Society for 1934 xxxi

B. LIGHTFOOT, A. M. MACGREGOR, and E. GOLDING: The meteoric stone seen to fall in the Mangwendi native reserve, Southern Rhodesia, on March 7, 1934 1

L. J. SPENCER: Murnpeowie (South Australia), a granular type of meteoric iron. (With Plates I–III) 13

J. ADAM WATSON: Colour reactions in the micro-chemical determination of minerals. (With Plate IV) 21

A. W. GROVES: The determination of small amounts of copper in rocks 35

A. R. ALDERMAN: Almandine from Botallack, Cornwall . . . 42

MINERALOGICAL ABSTRACTS

(Vol. 6, No. 1, Pages 1–48)

Notices of Books (p. 1).—Precious Stones (p. 4).—Meteorites and Tektites (p. 9).—Rock-forming Minerals and Petrology (p. 19).—Economic Minerals and Ore-deposits (p. 26).—Radioactivity (p. 32).—X-rays and Crystal-structure (p. 36).—Miscellaneous (p. 46).

PAGE

ADAMS, F. D. . . 26
ALOISI, P. . . . 4, 8
ANDRESS, K. R. . 40
AREND, J. P. . . 29
ASTAPOWITSCH, I. S. 16
AUBEL, R. VAN 28, 33
BACHMETEW, E. . 37
BARTH, T. F. W. 43, 45
BASSET, J. . . . 7
BELOT, E . . . 17
BERG, W. F . . 36
BERNEWITZ, M. W. 5
BHOLA, K. L. . . 32
BJÖRLYKKE, H. . 26
BLACKTIN, S. C. . 2
BORCHERT, W. . 11
BOUCHAL, F. . . 42
BOWEN, N. L . . 4
BRÆKKEN, H. . . 39
BRASSEUR, H. . . 42
BRILL, R. . . . 43
BROCKWAY, L. O. 39
BRUNI, G. . . . 40
CARPENTER, C. . 40
CAUCHOIS, Y. . . 36
CHARONNAT, R. . 30
CHOUBERT, G. . . 30
CHROBAK, L. . . 41
CLARK, G. L. . . 46
CLAUSSEN, G. E. . 29
COLBY, M Y . . . 44
COOKE, C. W. . . 16
COREY, R. B. 41–2, 45
COULSON, A. L. . 32
CULLISON, J. S. . 13
DANKWORTT, P. W. 3
DEANS, T . . . 28
DESCH, C. H. . . 1
DIAKONOVA-SAVELIEVA, E. N. 20
DICKINSON, B. N. 41
DITTLER, E . . . 11
DOLEJSEK, V. . . 42
DWYER, E. P. . . 8
EHLERS, J. . . . 11
EPPLER, A. . . . 5
EPPLER, W. F. . 5–6
ESCOLA, P. . . 25, 46

PAGE

FAIRCHILD, J. G. . 33
FENNER, C. . . . 18
FENNER, C. N. . . 4
FERGUSON, J. C. . 27
FERRARI, A. . . 40
FIGGINS, J. D. . . 15
FISHER, W. J. . 10
FLETT, J. S. . . 24
FOX, J. J. . . . 6
FOYE, W. G. . . 33
GEVERS, T. W. . 23
GOLDSCHMIDT, V. . 36
GOSSNER, B. . 42–3
GRATON, L. C. . . 4
GRAUPNER, A. . . 27
GRIME, H. . . . 40
GRUNER, J. W. . 45
GSCHWIND, M. . . 3
GUIMARÃES, D. . 7
HÄBERLE, D. . . 11
HÄGG, G. . . . 38
HANCOX, E. G. . 32
HARKER, D. . . 38
HARPER, J. P. . . 44
HART, G. . . . 5
HARTSHORNE, N. H. 2
HECHT, F. . . . 32
HEIDE, F. . . . 9
HELBERGER, H. . 8
HENDERSON, E. P. 14
HENDERSON, G. H. 35–6
HESS, F. L. . . 4
HITCHEN, C. S. . 33
HODGE-SMITH, T. . 17
HOLMES, A. . . . 32
HULTGREN, R. . . 42
HULUBEI, H. . . 36
ITO, T. . . . 43, 45
JANOSCHEK, R. . 18
JASKÓLSKI, S. . . 28
KATO, T. 31
KAWANO, Y. . . 22
KETELAAR, J. A. A. 40
KIESSLING, O. E. . 26
KIOSTER, A. . . 37
KLUG, H. P. . . 37
KÔZU, S. 21
KRAUS, O. . . 42–3
KRISHNAN, M. S. . 12
KUNO, H. . . . 19

PAGE

LACROIX, A. . 17, 20
LANE, A. C. . . 33
LAVES, F. . . . 38
LEBEDEFF, V. . . 30
LEECHMAN, G. F. . 6
LEISEN, E. . . . 19
LIGHTFOOT, B. . . 27
LINCK, G. . . . 19
LINDGREN, W. . . 3
LINDNER, J. . . . 48
LINSLEY, E. G. . 15
LOEWINSON-LESSING, F. Y. 1, 20
MCULURE, L. . . 31
MCMURCHY, R. C. 45
MARTIN, A. E. . . 6
MARTIN, R. . . . 19
MAWSON, D. . . 15
MEHMEL, M. . 41, 46
MELLOR, D. P. . . 8
MELTON, F. A. . . 16
MOONEY, R. C. L. 44
MUILENBURG, G. A. 13
MURDOCH, J. . . 9
NAKAMOTO, A. . 31
NÉMEC, F. . . . 18
NESPITAL, W. . . 41
NEUMAN, E. W. . 39
NEWHOUSE, W. H. 29
NININGER, H. H. 10, 14–15, 17
NOLL, W. . . . 25
OFFNER, F. . . . 38
ÖLANDER, A. . . 37
OWEN, E. A. . . 37
PABST, A. . . . 44
PARTRIDGE, F. C. . 31
PAULING, L. . . 39
PERRIN, R. . . . 24
PERRY, S. H. . . 13
PESTRECOV, K. . 45
PETERSON, A. W. 37
PHAUP, A. E. . . 27
PICKUP, L. . . . 37
PIÉRARD, J. . . 42
PIGGOT, C. S. . . 34
POLINARD, E. . . 7
POSNJAK, E. . 43, 45
PRATJE, O. . . . 25
PREUSS, E. . . . 19

PAGE

QUERVAIN, F. DE . 3
RAMDOHR, P. . 35, 46
RANDALL, J. T. . 2
RASSENFOSSE, A. DE 42
RAYLEIGH . . . 25
REINECKE, L. . . 31
ROBERTSON, R. . 6
ROCHE, S. . . . 30
ROSS, C. S. . . 4, 33
RÖSSNER, H. . . 34
ROTHÉ, E. . . . 34
ROUSH, G. A. . . 5
RUDAUX, L. . . . 11
SANTOS, J. A. . . 40
SAWATARI, M. . . 19
SCHADLER, J. . . 11
SCHALLER, W. T. 4
SCHOLTEN, W. . . 39
SCHULZE, G. E. R. 41
SELJAKOW, N. J. . 36
SHAND, S. J. . . 23
SHERMAN, J. . . 43
SILBERSTEIN, G. . 9
SKERL, A. C. . . 30
SLAVÍKOVA, L. . 12
SOBOLEV, V. . . 22
SOWS, E. I. . . . 36
SPENCER, L. J. . . 16
STOECKEL, F. . . 34
STUART, A. . . . 2
SUN, C. C. . . . 8
TAMM, O. . . . 48
TARR, W. A. . . 47
TOKODY, L. . . . 38
VAVRINECZ, G. . 48
VEGARD, L. . . . 37
WAINWRIGHT, G. A. 10
WATANABE, T. . 31
WEINBAUM, S. . 39
WELLS, R. C. . . 33
WERNER, C. O. . 46
WEST, C. D. 37–9, 44
WHIPPLE, F. J. W. 16
WYCKOFF, R. W. G. 41
WYLIE, C. C. . . 10
YOSHIKI, B. . . 22
ZACHARIASEN, W. H. . 43–4, 46
ZIEGLER, G. E. . 44

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